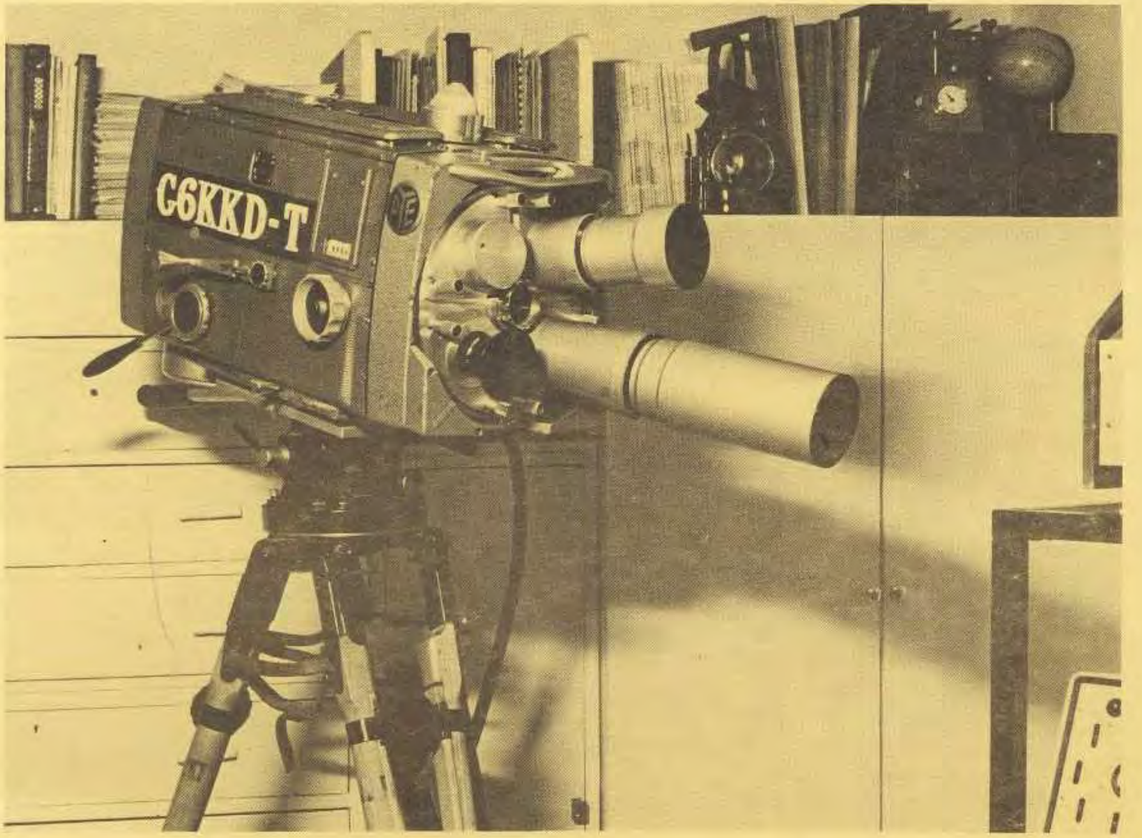

CQ TV

NOVEMBER
1971

76

THE JOURNAL OF BATC

THE BRITISH AMATEUR TELEVISION CLUB

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EDITORIAL

Do you always ignore page 1 and its list of committee members names? Or do you just wonder who they are and what they do. Well, as you have probably realised, all of them spend a fair percentage of their time working for B.A.T.C. for FREE! Mad, aren't they?

Any organisation, even one as small as B.A.T.C., must have some form of direction and this function is fulfilled for us by the committee which holds itself as representative of the entire membership of the Club. This last fact means that it is a large body of men - it could be bigger; but it meets regularly and decides on Club policy, action, recruiting and a whole host of other details necessary to the well-being of the Club. Some members hold defined posts, such as Secretary and Treasurer; but most are committee members with no fixed brief, ready to do any work the Club may wish, such as negotiating with MinPostel over license conditions, organising an exhibition, writing material for publication, answering members letters and problems - there's so many things to do!

Every alternate year at the Club Convention some committee members resign and new ones are elected. So next year, think whether you would like to give the Club some of your time - or whether you would just like to feel grateful to those others who have done. Anyway, give them all your support - they need it!

Have you been following the video cassette revolution? Next year Phillips will introduce a new domestic cassette VTR machine whose price should be such as to make anyone who can afford a second-hand tv set want to rush out and buy one.

The buyer of home VTR equipment will first want to study the market and decide which system he wishes to buy, and how much to pay for it. THAT is where the problem starts!

There's Cartrivision at £300, Videocassette at £200, Videodisc at £100, there's the Nord Mende Super 8 system for £250, Selectavision for £200, Instavideo for £100, the EVR Teleplayer for £350 and the VCR using a Phillips cassette at £250 and more and more and more....

Just a lot of names, so what do they mean in terms of systems? Some are just telecine machines using a flying spot scanner and a cartridge of film usually Super 8mm, and offering playback facilities only. Vidicord and EVR are examples of this type.

A more interesting group use ½ inch or [illegible] inch tape cassettes in helical scan machines, and can thus offer both record and replay facilities. The cassettes are expensive of course, but can be used again and again, unlike the film version. Examples of this system are Phillips VCR and Sony.

Some other systems use cheap recording materials, but this results in a playback facility only in the home. Selectavision makes use of plastic coated ribbon; Videodisc uses discs made of foil coated plastic; there are others of which we have very few details at present. In fact we have few details about systems in general at the moment but in about a year the shops should be full of machines and it is because of this that we have given this brief summary of the situation.

THE EDITOR.

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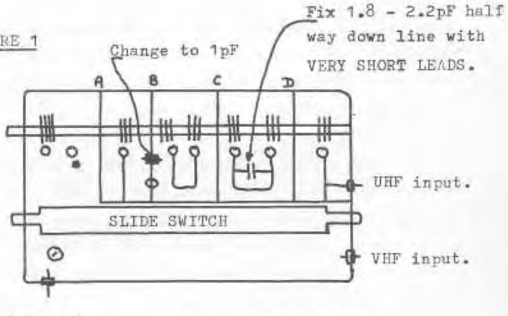
Converting a Transistorised TV Tuner for 70cm Amateur TV Reception.

by G3ZUL

FIGURE 1



Top view of convertor

The main type of tuner still available on the surplus market is the 3-band, transistorised quarter wave line type. These tuners contain four transistors and can be made to cover 144MHz and 70MHz as well as the 432MHz band. They are "wide band" converters and are thus not really suitable for AM communication working, though they make a good start for 70cm.

Referring to Fig. 1, the following procedure will convert the tuner.

a) Adjust all trimmers to maximum with the exception of the one marked * which should be left alone

b) Fix a 1.8 - 2.2 pF ceramic capacitor half way up the line (as shown) using the shortest possible wires.

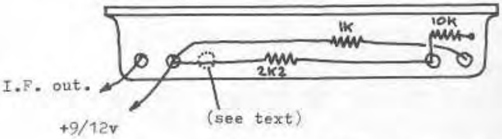
c) Change the 0.65 pF capacitor which goes through the screen at B to 1.0 pF.

It is now necessary to add biassing circuitry, and this is shown in Fig. 2. The dotted circle indicates that some tuners have a further feed-through at this point, but for our purposes this is ignored. After adding the biassing components, the power should be applied and a check made of the current consumption, which should be 8 - 10 mA at 9 volts. Any great deviation from this indicates a fault. With this type of tuner any fault can normally be seen, e.g. a broken lead. If all is correct, proceed as follows:

Connect the I.F. output of the convertor to a tv receiver input socket and tune the set to channel 1. (Check that the set has coils for this channel). Adjust the I.F. output coil of the convertor to suit channel 1 by peaking for maximum noise output. Finally, a 70 cm signal (from some nearby cooperative /T amateur) should be tuned in and all the trimmers readjusted for optimum performance.

FIGURE 2

Side view of convertor.



NOTE: negative earth

A TRANSISTOR MONITOR

Martin Allard G6AEM/T

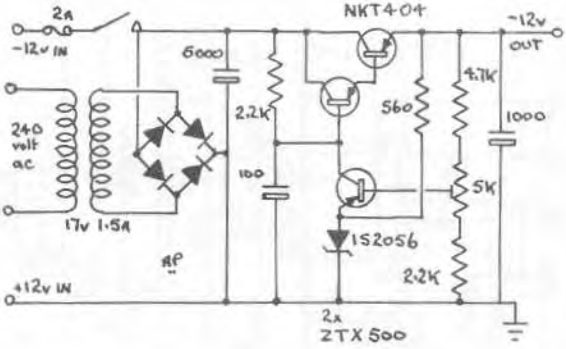
During a recent light-hearted tv dx-pedition around the Midlands and Wales, with a complete tv station in the back of a Mini, considerable interest was shown by a number of people whom I visited in my homebuilt 12 volt 625 line monitor. Very few people seem interested in building monitors these days, but this may be due to a lack of designs. In view of the current upsurge in interest in portable amateur tv, there must be some who feel that this exercise is worth while, so I present my own design here.

I feel I have acheived suprisingly good results at a fraction of the price of any commercial portable tv set, and have hit no major snags at all in the process. Most of it is designed not so much for economy of components, as to be easy to get going.

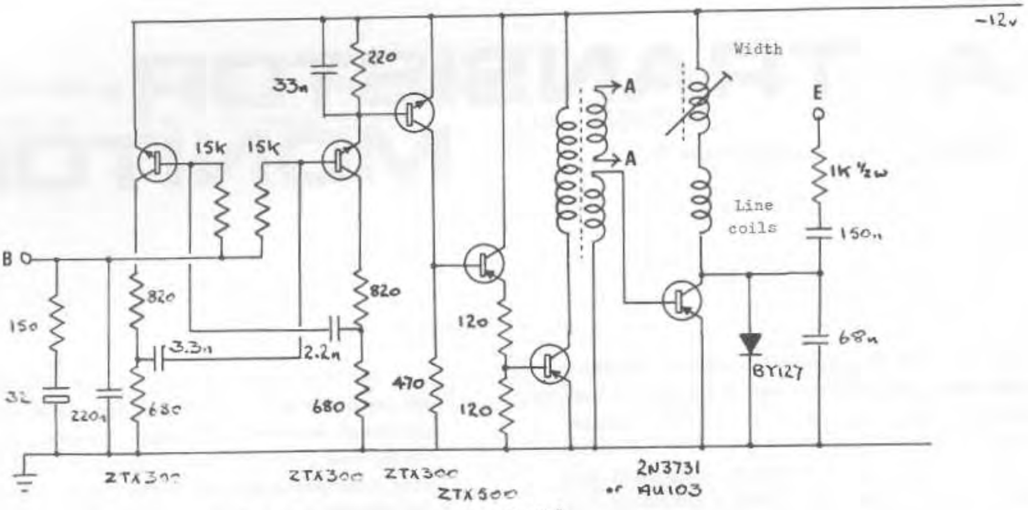
The monitor uses a 21cm tube type AW21-11 with scan coils and line output transformer from a Perdio 405 line portable set. This l.o.p.t. has recently been available at a surplus price of 37½p (J. Birkett).

Designed exclusively for 625 lines, the monitor has separate line output and e.h.t. stages. This would not be essential for a 405 line version. Back-porch clamping is provided and the overall resolution on 625 lines is primarily limited by the spot size of the c.r.t. The dimensions of the aluminium cases are 23 x 16 x 23cm. and the total consumption from a 12 volt battery is 1.2 amps.

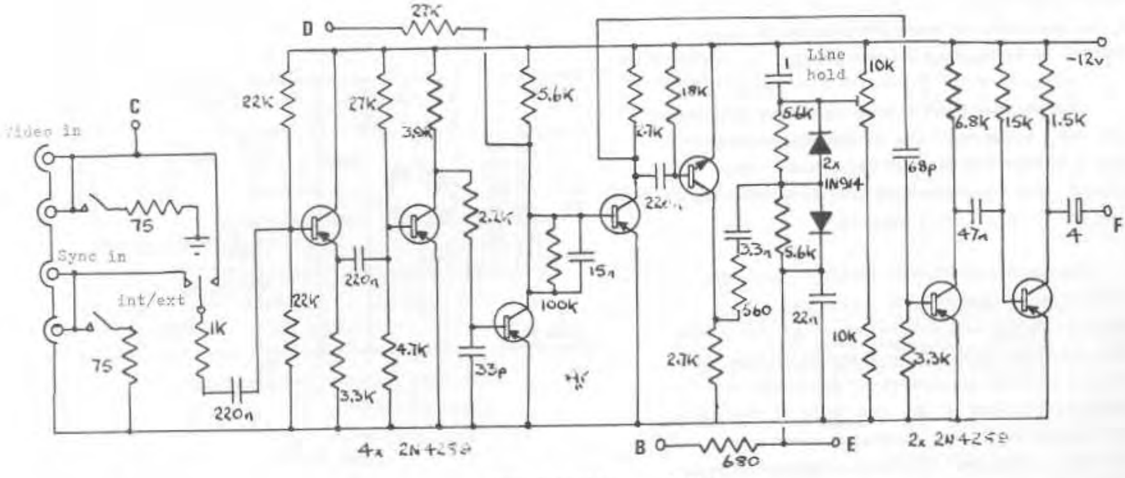
The line driver transformer uses a LA2503 pot core with a 200 turns 38 s.w.g. primary and 50 plus 50 secondary windings. The l.o.p.t. tuning coil for 625 lines is 60 turns of 26 s.w.g. wire on an 8mm former with slug, and is adjusted for maximum e.h.t. voltage. The width control is 25 turns of 18 s.w.g. on an 8mm former with slug, and linearity correction, which was not essential on the prototype, may be provided by a small magnet positioned near it. The dc connection of the line coils simplifies circuit design, and is easily offset by the centering magnets.



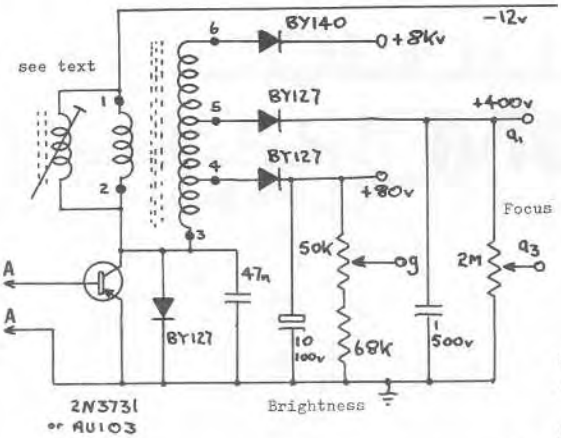
Power Supply



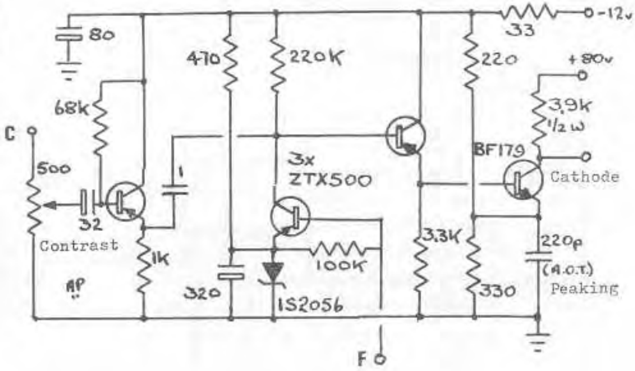
Line Timebase



Sync Circuits 2N706

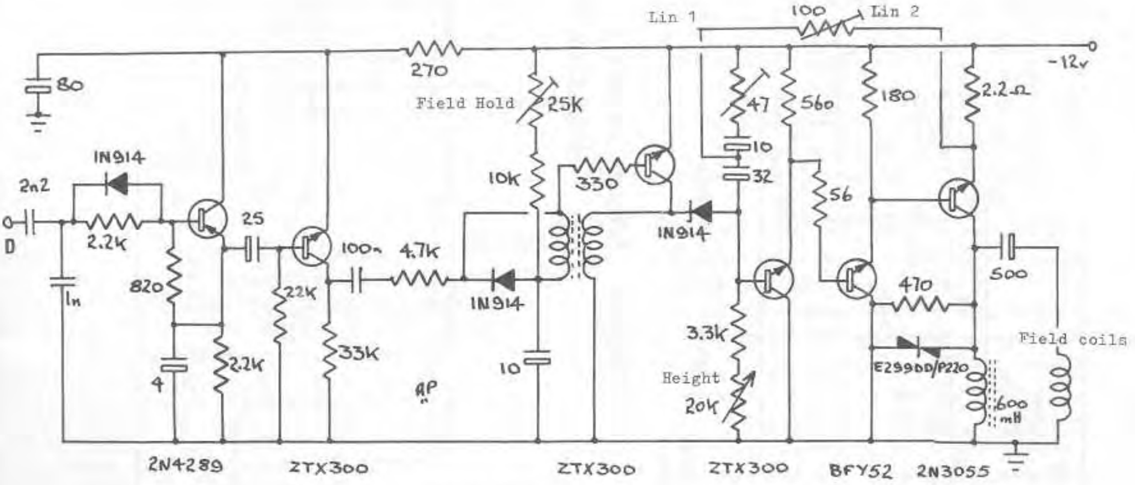


Most small audio transformers will perform in the field oscillator circuit, although the inductance will affect flyback time. The ratio is about 3:1. The sync separator is somewhat complex, but has good performance on varying signals in the presence of noise and subcarrier. The supply regulator is not vital for the normal range of car battery voltage, but is of course needed for mains operation.



Above: EHT Unit

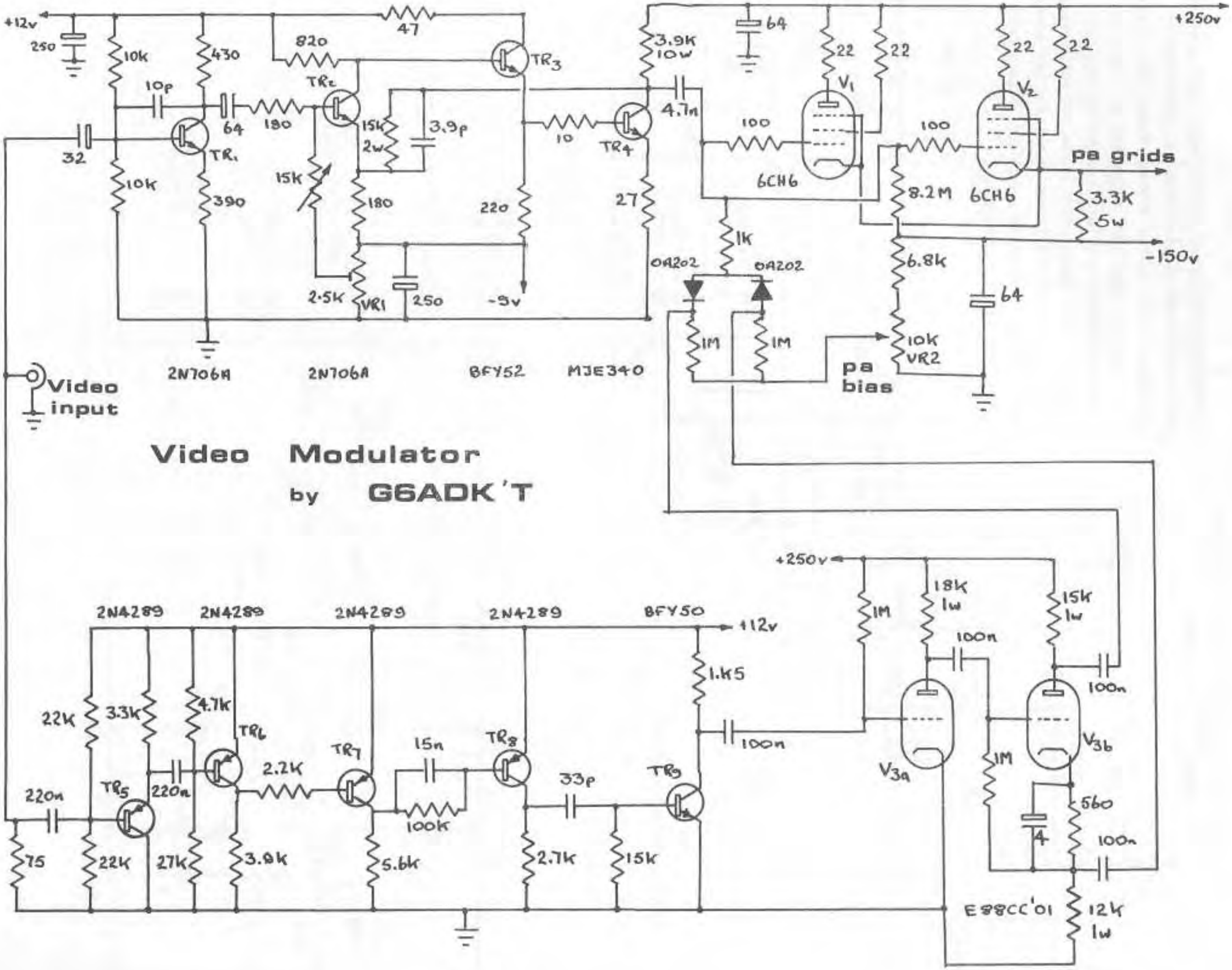
Right: Video amplifier



Field Timebase

Video Modulator

by G6ADK'T



A COLOUR VIDEO MODULATOR

Nigel Walker G6ADK'T

The transmitter is very likely to be the main source of distortion in any television system, and now that colour is here, the effects of any distortion are going to be much more severe than in the past. A form which affects both monochrome and colour is lack of bandwidth; however, it can be seen that this is going to have a much more significant effect on colour transmissions than on monochrome, in fact it could go un-noticed in the latter.

Unfortunately, we now come up against many conflicting requirements. For instance, high efficiency people like to use high Q cavities which will naturally restrict the bandwidth of the transmissions - so, sorry, no cavities! The only answer is to use (relatively) low Q lines; but if you are using a 6 - 40 or a 3 - 20 you will be using lines anyway.

My transmitter uses a pair of 4CX250B's in an ordinary push-pull arrangement using quarter-wave lines. The bandwidth restricting element now is the loading that the P.A. grid circuit has on the modulator, this also giving rise to chrominance/luminance crosstalk. This can be VERY severe if you are not careful, the effect being that the chrominance signal tends to get converted into luminance levels due to the grid rectification of the P.A. This obviously results in incorrect luminance, as well as insufficient colour.

Although I am a great believer in transistors, I felt that valves would provide a much more economical solution to the problem. Accordingly, the output stage of my modulator uses a pair of 6CH6 valves in parallel to form a cathode follower of siutably low output impedance. In the grid circuit there is a clamp which sets the dc level of the video waveform so that it can be directly coupled to the grids of the P.A. The signal is, in fact, clamped to sync-bottoms as this overcomes simply the problem of gating out the burst from the back porch.

CIRCUIT DESCRIPTION

TR1 - TR4 form a voltage amplifier; TR4 should be mounted on a 24sq.cm. heat sink. VR1 should be set so that the dc on TR4 collector is 180 volts.

TR5 - TR8 form a sync separator, TR9 and V3 being the clamp pulse generator. It must be stressed that decoupling of all supplies is even more important for colour than monochrome, as the subcarrier can so easily be lost. An oscilloscope can be very usefully used to check for spurious signals appearing on the supply rails. Use discs in **parallel** with electrolytics as decouplers - but do make sure that they do not form tuned circuits! Do not forget to decouple the e.h.t. feed to the P.A., as subcarrier can easily get lost down this route.

This modulator was designed to give both a linear frequency response and a linear transfer function. It was intended that any equalisation and linearity correction would be accomplished in a separate unit, and this would normally be on the input to the modulator proper.

RESULTS

Tests have been carried out between this station and G6AEM/T, a distance of 23 miles. Transmitting colour bars, and viewing on a colour monitor, no distortions were visible at all. On the 'scope however, very slight chrominance/luminance crosstalk was observed, but not enough to worry the user, who is quite satisfied with the unit.

EDITORS' NOTE

G6ADK/T will be starting a series of articles on colour television for amateurs in the next issue of C Q - T V dated February 1972

SLOW SCAN NEWS

In SSTV News last time we printed a photograph from W4MS of signals received from G5ZT, Harold Jones of Plymouth, together with a few notes on Harolds' contacts.

'ZT has now sent a complete log of his contacts over the period 23rd April to 10th June, and I wish we had the space to print it all! Almost every day produced a string of contacts, some a very large number indeed. Such as the 26th May with 14 two-way contacts with the U.S.A. And the 23rd June which reads:-

VK6ES	14MHz	2-way QSO	(40 mins)
I1LCF	14MHz	2-way QSO	
W3KAU	14MHz	2-way QSO	
WA6RNG	14MHz	2-way QSO	
W9EWC	14MHz	2-way QSO	
WAOVZF	14MHz	2-way QSO	
K5MVP	14MHz	2-way QSO	
K9BTU	14MHz	2-way QSO	
KL7DRZ	14MHz	2-way QSO	
SVOCG	14MHz	2-way QSO	

And some people say sstv will not catch on!

W8CH received in June

SZOCG's daughter

W4LAS's niece

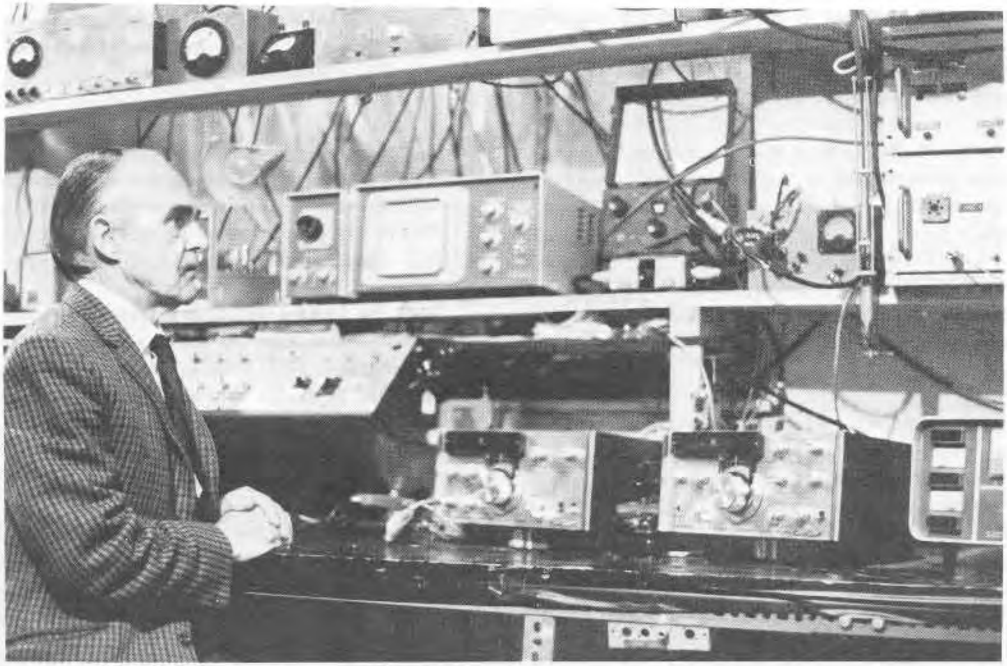
The large photograph shows the G5ZT shack; on the shelf are the Robot camera and monitor, while below, left to right, are the Trio Tx599 and JR599 transmitter/receiver. With this rig contacts have been made with Singapore, New Zealand and U.S.A. as well as the nearer European countries. Some of the smaller photographs printed here show the picture quality received.

Some of the records Harold claims are W4TB, FG7XT and W4UMF as G firsts on 21MHz, and OZ8MG, HKDEH, KP4GN, KL7DRZ and VK6ES all G firsts for two-way QSOs on 14MHz.

Harold's last comment is "Having a wonderful time working sstv stations, there's no shortage of contacts. I foresee a wonderful future for slow scan!"

Anyone else going to join in?

SM4AMM received on 14MHz



A UHF VIDEO MODULATOR

David Taylor G6SDB'T

The object of the unit described here is to enable a camera, or other source of standard video waveform, to be fed into a standard uhf television receiver via the aerial socket, with no modifications to the set being necessary. In particular it enables rented colour tv sets to be used for amateur experiments without internal connection.

Voltage Levels

The video input is for one volt peak to peak and can be terminated or bridged, although the modulator was designed with termination in mind. There is sufficient gain margin to accomodate levels less than this.

The output level is more than sufficient to feed several tv sets, but it can be reduced without affecting modulation performance by detuning the drive.

The voltage rail is 12 volts, chosen as it is compatible for most transistor circuits and most convenient for portable operation.

Circuit

The basic modulating element is a P-i-N diode, whose rf conductance depends on its forward current. It is arranged as a series element, controlling the rf fed from a crystal controlled oscillator chain.

The video signal is amplified by transistors T1 T2 and T3. As the diode has a logarithmic characteristic, T3 is arranged to give an anti-log one, and to provide constant current drive to the P-i-N device. The peak voltage developed across R12 is proportional to the peak sync amplitude of the carrier and is maitained constant by rectifying the peaks with D1 and using the resulting dc for biasing T1.

C2 provides a measure of high frequency compensation, but may not be necessary depending on the transistors used. It is important to keep the stray capacitance at T3 collector as low as possible and to this end C5 and C6 are made as small as possible.

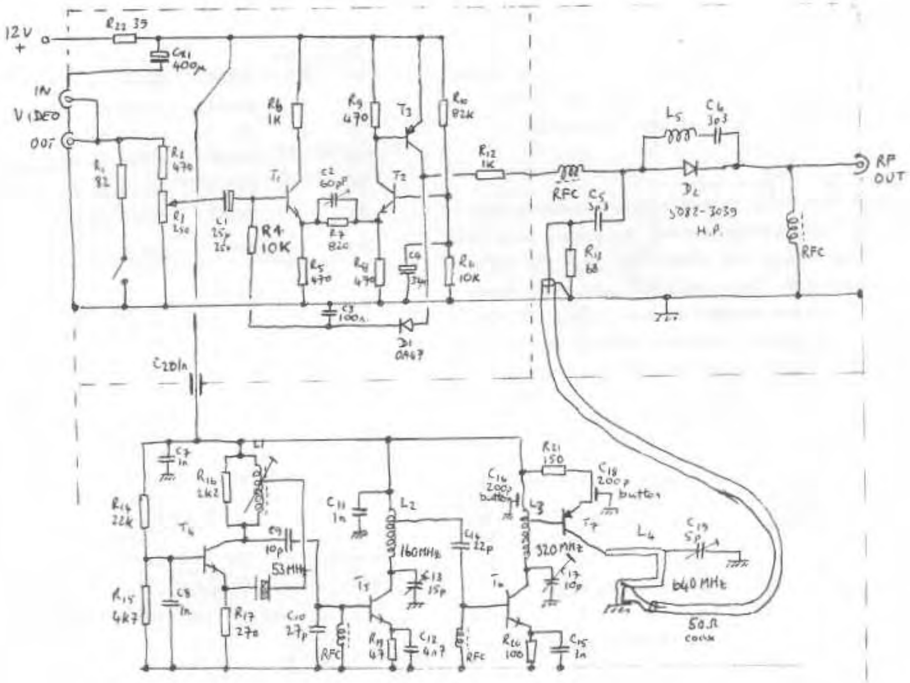
Oscillator Section

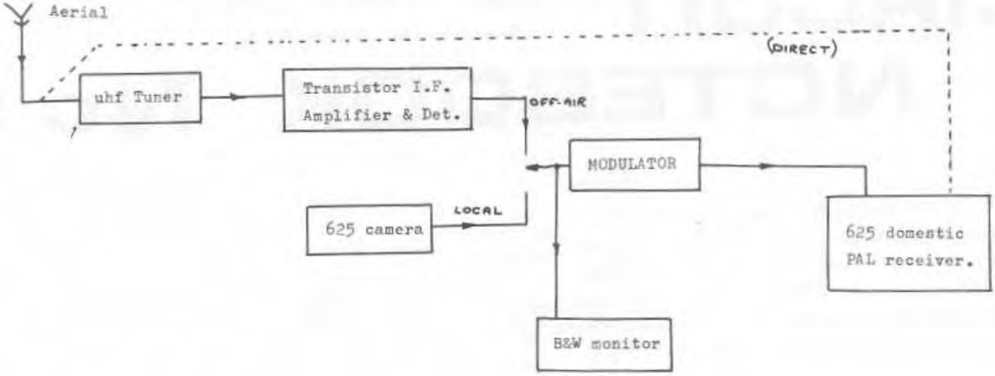
This is conventional enough and an LC oscillator could perhaps be substituted. The circuit feeds the rf across R13, whose purpose is to stabilise the impedance presented at that point.

With the appropriate neutralisation coil (L5) there is no reason why the modulator should not be used down to the VHF channels. The oscillator section should be tuned for maximum output by monitoring the voltage across R19, R20, and R21 or at rf on the output frequency.

Results

With the gain correctly set (just so far up that) peak white crushing does not occur) the pictures on closed circuit and through the modulator were virtually indistinguishable. The only notice-


12V +
R22 33
C21 400μ
IN
VIDEO
OUT
R1 82
R2 470
R3 250
C1 25μ 25v
R4 10K
R6 1K
R9 470
T1
T2
T3
C2 60pF
R7 820
R5 470
R8 470
C6 3μ
R10 82K
R11 10K
C3 100n
D1 OA47
R12 1K
RFC
C5 3p3
R13 68
L5
C6 3p3
D2 5082-3039 H.P.
RF OUT
RFC
C20 1n
C7 1n
R16 2k2
L1
R14 22k
R15 4k7
T4
C9 10p
53MHz
C8 1n
R17 270
C10 27p
RFC
C11 1n
L2
160MHz
C13 15p
T5
R18 47
C12 4n7
C14 22p
RFC
R21 150
C16 200p button
C18 200p button
L3
T7
320MHz
C17 10p
T6
R20 100
C15 1n
L4
C19 5p
640MHz
50Ω coax


Aerial
(DIRECT)
uhf Tuner
Transistor I.F. Amplifier & Det.
OFF-AIR
MODULATOR
625 camera
LOCAL
625 domestic PAL receiver.
B&W monitor

TEST SET UP

able was a slight increase of saturation with PAL colour pictures. The 6MHz intercarrier sound was somewhat reduced, but this was due to the off-air source having good 6MHz rejection!

Construction

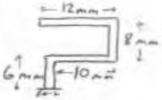
The whole modulator is built into a tobacco tin with a dividing screen across the centre parallel to the long side. The oscillator is built into one half and the video amplifier and diode (separated by another screen) in the other. In the prototype Belling Lee coaxial connectors were used, and a preset multiturn pot was the gain control.

Coil Data

Coil	Turns	Swg	I.D.(mm)	length(mm)	Tap
L1	8	26	7	c.w.	1
L2	4	20	6	5	$1\frac{1}{4}$
L3	2	20	6	14	$\frac{3}{4}$
L4		18	see diagram below		
L5	$6\frac{1}{2}$	28	4	7	
RFC	$2\frac{1}{2}$	26	on FX1115 former.		

Parts List

T1 T2	BCY89	could be vhf npn silicon
T3	ME0413	could be vhf pnp silicon
T4	BF115	could be vhf npn silicon
T5	T1S48	could be vhf npn silicon
T6	BF173	could be vhf npn silicon
T7	AF239	could be uhf pnp germanium
D1	OA47	could be gold bonded germanium
D2	5082-3039	could be any P-i-N diode with small carrier lifetime less than 100nSec



CIRCUIT NOTEBOOK No 9

VIDEO AMPLIFICATION

J. Lawrence GW6JGA'T

In ATV equipment, video frequency amplification generally creates the greatest problems. Here is a simple, and well tried commercially, two transistor video amplifier circuit which has a medium input impedance, around 5K ohm and very low output impedance.

The circuit has the two transistors connected in cascade with series voltage feedback applied. The basic circuit is shown in Fig. 1.

For small values of voltage gain around X10 or so, the actual gain is almost independant of transistor characteristics nad is very nearly equal to $\frac{R2 + R3}{R3}$.

The negative supply is usually fed from the negative supply rail through a suitable resistor R4 the value of which determines the operating current of VT2. This is in addition to the gain determining resistors R2 and R3 and is therefore decoupled for all operating frequencies by C1.

The gain can be made adjustable if desired by including a variable resistor to adjust the ratio of the feedback resistors.

Almost any small signal HF transistors will work in the circuit but ideally they should have a high cut-off frequency, reasonably high current gain and low output capacitance.

In deciding on circuit values, the value of R3 should lie between about 22 ohms and 100 ohms and the value of R2 chosen to suit the gain required.

The operating current for VT2 is determined primarily by R2 + R3 + R4 and for a -12 volt supply this is given approximately by:

$$\frac{12000}{R2+R3+R4} \text{ milliamps.}$$

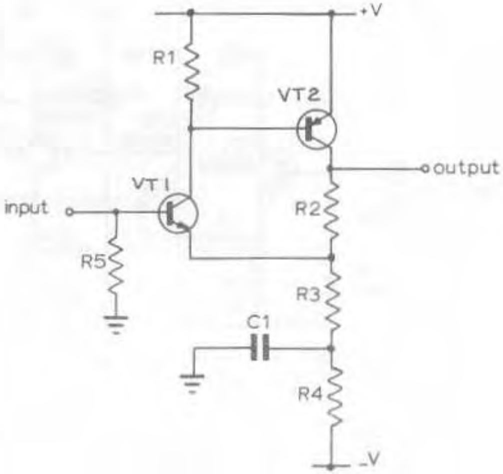


Fig. 1.

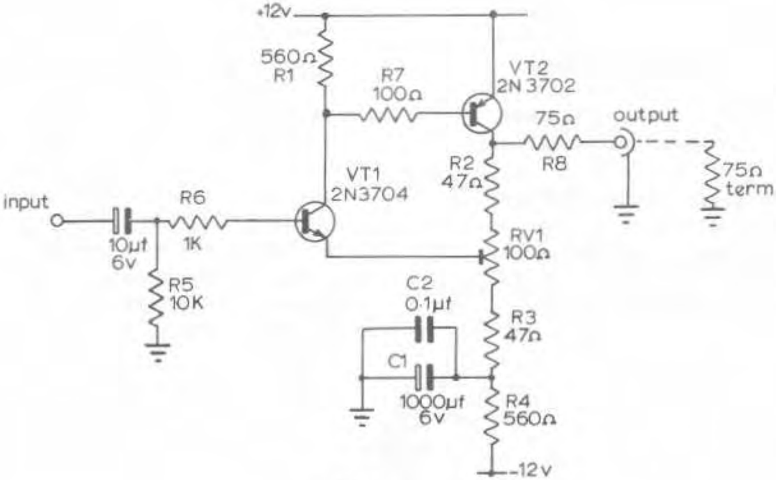


Fig. 2.

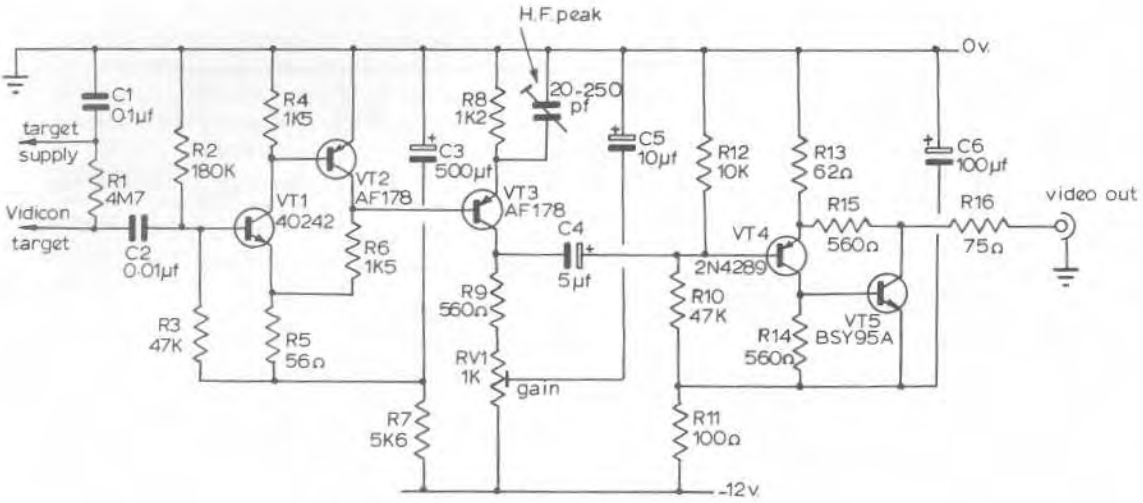


Fig.3. Video head amplifier

Typical values lie between 2.2Kohms (about 5mA) and 470 ohms (about 20mA). The higher current is required, for example, when an output stage is required to drive a 1 volt p-p video signal into 75 ohms.

The operating current for VT1 is determined partly by R1 and typical values are 1Kohm (0.6mA) to 220 ohms (3mA). When used as a head amplifier and low noise operation is required, a low operating current should be chosen.

In a practical circuit the bandwidth may extend to 15MHz or so and sometimes it may be necessary to include stopper resistors in each base circuit to restrict the maximum high frequency response and eliminate possible parasitic oscillation.

The circuit in Fig 2 is a typical arrangement for a video output or distribution amplifier feeding into a 75 ohm terminated line.

The stopper resistors are included in the circuit diagram, but may not be necessary in every case.

A typical circuit for a vidicon head amplifier is shown in Fig 3. The first pair of transistors are run at low current, where the signal amplitude is low and low noise performance is important. The second pair are run at higher current to provide a normal level output signal. The two stages are coupled together through a single transistor amplifier which provides high frequency peaking and control of the overall gain.

THE CQ·TV SPG

A TRIPLE STANDARD MONOCHROME SPG using TTL.

by A. W. Critchley Dip El, C Eng, MIERE. **Part 2.**

CONSTRUCTION, adding COLOUR PULSES and GENLOCK.

At the time of writing approximately 10 of these SPGs have been constructed in one form or another. All have worked in a satisfactory manner but some points have been noted about the performance and also some errors have been found in the first part of this two-part article. The errors will be dealt with first.

Errors in Part 1, CQ-TV 75

Page 3 - 'see figure 4D' should be 4C. In the second line from the end of the page - figure 4 should be 4J.

Page 4, line 6 - figure 4E should be 4D. In the last two paragraphs - pin 9 should be pin 12. Figure 1, the arrow to pin L (by S1C) should be to pin H.

Page 6 - Figure 4 - delete 'Field Blanking ÷2 stage N10AQ' from M and N and substitute 'N7A pin 12'. Delete 'This waveform .....counter)' from M and add 'Simple counter on short Field Blanking only' on N.

Page 8 - Simplification, paragraph 3 - R7 and 8 should be N7 and 8.

Page 9 - Figure 7, ÷2 N8B should be N8A. Setting-up, delete item 7. Note that the setting-up is given for 625 only.

Page 10 - R17 should be 3.9KΩ only.

Modifications

The first change is made to improve the range of the Equalizing Pulses control - R18 should be reduced to 3.9 KΩ.

The system of adding the colour pulses has been changed with the result that C13 is no longer necessary.

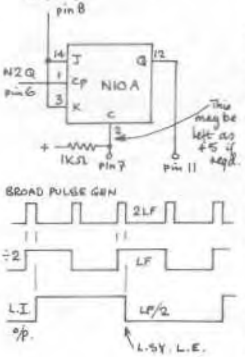
Certain resistors may, or may not, be essential as they are included to ensure quiescent biassing. These are R5,27,28,30,31,32 and 43.

Line Ident

The Line Ident bistable N10A is fed from a source which is 4.7 µs too soon due to an oversight during the design of the SPG. It should of course be timed at the leading-edge of Line Sync. However, this particular timing is not available at line frequency.

The circuit should therefore be modified as shown in the diagram. This modification uses the twice-line frequency pulses from the Broad-pulse generator N2 Q-output to trigger the bistable on the negative-going trailing edges. Here, the pulses have the correct timing. Unfortunately, they are at twice the line frequency.

Line Ident Modification



The J and K-inputs of the bistable have to be used to gate the bistable action on alternate trigger pulses. This is most easily done by using the divide-by-two interlace-bistable output at line frequency from N13B.

Since the bistable can not clock if both J and K are low, this gives a simple method of performing the gating because the J and K inputs are together made high and low on alternate lines.

The bistable output frequency is therefore at half of line frequency as required; it is also at the correct timing.

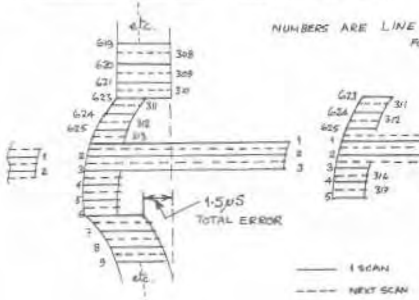
The modification to the printed circuit board is basically simple because the feed from N2Q is already nearby and N13 is also adjacent. The problem is that the J and K inputs are joined up to the +5-volt rail. The track shown in figure 11 is not modified in this way.

A furthur modification which might be useful in the future for colour genlocking is to connect N10A pin 2 to the plug pin 7 (where C13 was) and to add a 1kΩ resistor to +5-volts. This will enable the phase of the Line Ident to be corrected if necessary to suit a four-field sequence of pulses which occurs due to the use of the PAL system. It may also be necessary to change the input phase to the J and K inputs from the Q̄-feed to the Q-feed of N13B instead. Alternatively the output of N10A could be from the Q̄-output.

Phase-modulation

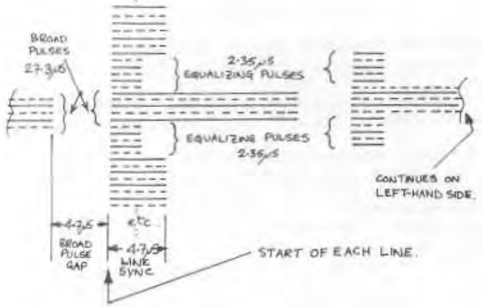
A slight modification to the SPG to cure a bit of phase-modulation is desirable though not essential. This shows as a line-timing error lasting for the duration of the Field Drive period followed by another opposite error. This 'kink' is shown in figure 1 which depicts the Composite Sync signal as displayed on a picture monitor with a half-scan delay in each direction. The maximum amount of error is 1.5µs. Whilst this does not cause any visible trouble on a picture it might as well be eliminated as a single resistor will cure it!

Fig 1. Phase modulation of Lines (Exaggerated)



The cause of the trouble is that the master oscillator is in the same package as the Field Drive NAND-gate and when the latter turns on it changes the supply voltage to the oscillator which changes it's frequency. When the field period is over the oscillator frequency returns to normal. It is this change and return which gives rise to the kink. Fortunately the cure is very simple - introduce an opposite effect from the same source to cause cancellation. A 300KΩ resistor (R44) from N1B pin 12 to N1A pin 6 is required. Figure 2 shows the corrected result.

Fig 2 Correct Field Sequence - 625



External Oscillator

The use of an external oscillator instead of the internal one is catered for in this SPG. Putting an earth onto pin 1 of the plug will cause the internal oscillator to stop. An external source can then be fed in via pin 3 to the Schmitt-trigger input of the Broad-pulse monostable N3. This source must be from +0.8 to +1.5 volts minimum. It should preferably be from a TTL gate, although the risetime is not critical. A positive-going edge is required at 1 KΩ impedance.

Internal Oscillator

The internal oscillator frequency should be set to 31.25 KHz on 625 (31.5 KHz on 525) by means of R3 when VR1 is central. The 405 frequency should then be within the range of VR1 when C3 and C4 are added. If not, then C4 will have to be altered.

Incidentally, if R11 is omitted the 405 line-delay becomes 6 µs and the Front Porch 3.4 µs. This is rather large but may be acceptable in order to save a switch pole.

Second Counter

The feedback resistors R25 and R26 are only 470 Ω whereas the feedback resistors in the Main Counter are 1 KΩ. This is necessary because of the 0.6 volt drop of the diodes D13 and D14 which form an AND-gate.

Use on 625 only

If the multi-standard facility is not to be used then the SPG can be considerably simplified by the omission of several components. These, and other necessary modifications are listed below.

Delete S1, N9, all diodes, C3, C4, R11, R19 to 27, R30 to 34.

Replace R20, R23, R33 and R34 by links.

Ensure that R19, R21, R22 and R 24 are not linked.

Transfer the field-group clock, which goes to N12 pins 1 and 5 and N13 pin 1, from N9 pin 11 to N5 pin 11.

Link pins J and L only.

All the counters should now count by 5.

For 525 only

It is not possible to dispense with N9 unless the arrangement of figure 7 (CQ-TV 75 page 9) is used. The details given here are not for figure 7, but are for use with the printed circuit board whose details are given later in this article.

Delete S1, all diodes, C3, C4, R11, R19 to 27, R30 to 34.

Replace R19, R21, R23, R33 and R34 by links.

Ensure that R20, R22 and R24 are not linked.

Join N9 pins 12 and 1 to pin 6.

Link pins J and L only.

The counters N5 to N9 should now count by 3,7,5,5 & 6 respectively.

For 405 use only (Version with Equalizing pulses)

Delete S1, all diodes except D13 and D14, R19 to 24, R30 to 34.

Replace R19, R22, R24, R33 and R34 by links.

Ensure that R20, R21 and R23 are not linked.

Join pins A and B, A and C, J and L only.

The counters N5 to N9 should now count by 3,5,3,9 & 8 respectively.

405 U.K. version (i.e. BBC/ITA)

Repeat the modifications as for 405 with equalising pulses, but link pin L to K instead of to J. Also, do not replace R33 and R34 by links. D15 and D16 should be replaced by 1 KΩ resistors and pin H joined to pin D in order to bias N1A pins 1 and 2. However, it is not essential to do this. Instead, N1A pins 1 and 2 could be linked to N1A pins 4 and 5. They could be left open-circuit too with no harmful effects. If the SPG is not being made on the printed circuit board described later, then a rearrangement of N12 and N13 could also save an IC, since N12B and N13A do not contribute anything on 405 UK.

Standards Switch wiring.

Fig 3. Standards Switch-Circuit

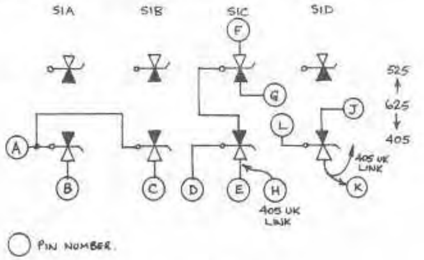
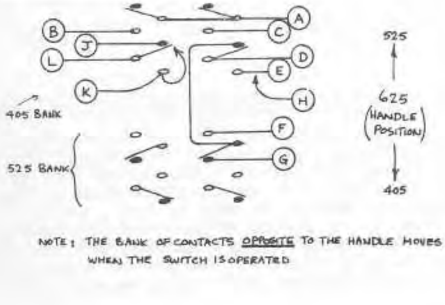


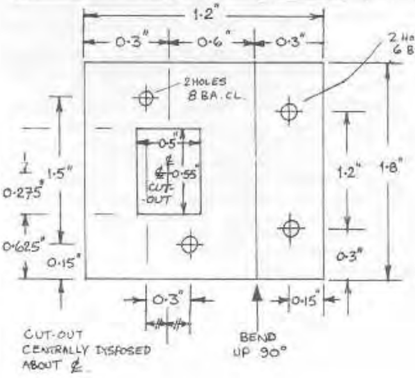
Fig 4 Standards Switch - Wiring



NOTE: THE BANK OF CONTACTS OPPOSITE TO THE HANDLE MOVES WHEN THE SWITCH IS OPERATED

If the multi-standard version is to be built then the standards switch is required to be a 3-way, 4-pole type. A miniature lever-key type is perhaps the most convenient and the connections are shown for such a switch. Note that the bank of contacts opposite to the direction of handle movement is the one changed by the movement.

Fig 5. Standards Switch Mounting Bracket (Not to scale)

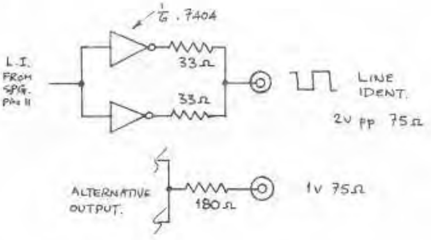


Adding Colour pulses.

Line Ident

This is already generated in the SPG but may need to be retimed as mentioned earlier. It needs only an output stage to complete it. This is shown in figure 6.

Fig 6. Line Ident Output



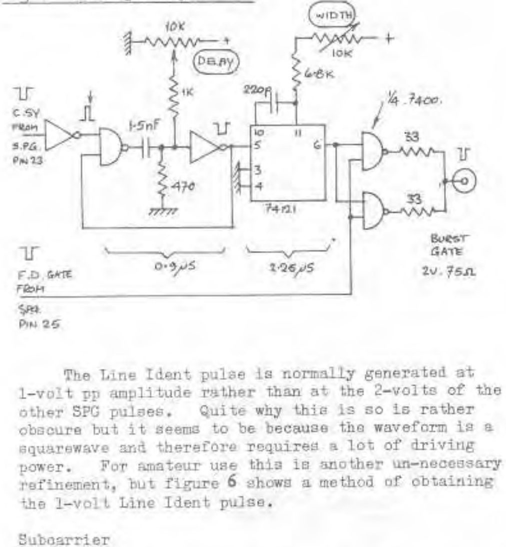
Burst Gate

It was originally intended to use the feed of sawtooth via C13 from the Line Blanking monostable to drive another monostable on its schmitt-trigger input in a similar manner to N3 in order to obtain the Burst Gate pulse. However, whilst this did work, it was found to be unstable as the sawtooth waveform at the required time is of a low slope. Consequently, large changes of delay timing are brought about by small voltage changes. This was considered to be unsatisfactory and a second monostable was added to provide the necessary delay. The inherent poor stability of this monostable is minimised by making its period as short as possible. This is achieved by using the trailing-edge of Line Sync as the trigger so that the delay is only 0.9 µs. The output of this monostable triggers the second one which produces the pulse of 2.25 µs forming the Burst Gate pulse.

Simple field-period blanking is employed to remove the twice-line pulses from the output by using Field Drive as the blanking pulse.

This simple 7½ lines blanking does not match up the professional system using 'Bruch' blanking of 9 lines per field period (625 PAL). In this system the 9-lines period is moved around over a four-field sequence to ensure that the receiver sub-carrier oscillator always starts with a constant phase after each field **stoppage**. The reason for this is that it prevents colour distortions occurring at the top of the picture whilst the oscillator readjusts its phase. For amateur use this is rather a refinement. In any case suitably timed pulses are not available in the SPG. The 525 lines system does not use this form of Burst Gate blanking anyway.

Fig 7. Burst Gate System



The Line Ident pulse is normally generated at 1-volt pp amplitude rather than at the 2-volts of the other SPG pulses. Quite why this is so is rather obscure but it seems to be because the waveform is a squarewave and therefore requires a lot of driving power. For amateur use this is another un-necessary refinement, but figure 6 shows a method of obtaining the 1-volt Line Ident pulse.

Subcarrier

This is not normally generated by the SPG and so no provision is made for it in this SPG.

The usual system is for the sub-carrier oscillator frequency to be divided-down to the twice-line frequency by a chain of bistables. However, this is not so simple as it may seem, because the relationship between the two frequencies involves a fractional number. For amateur use, therefore, this complication can be avoided by using a free-running crystal oscillator. The subcarrier patterning at the receiver will probably be no greater than the usual amount of 'hash' observed on low-strength signals.

For those who want to experiment with a counter chain the relevant relationships are given. Figures 8,9 and 10 show possible methods for both 525 NTSC and 625 PAL systems.

The subject of Subcarrier to twice-line counting will be the basis of a future article.

Fig 8. Counting Subcarrier down to 2LF - 525 NTSC

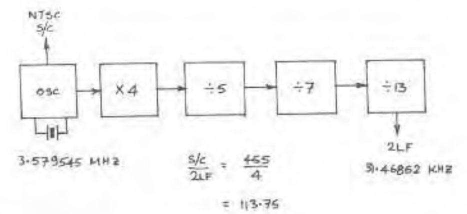


Fig 9 Counting Subcarrier down to 2LF - 625 PAL - 1st method.

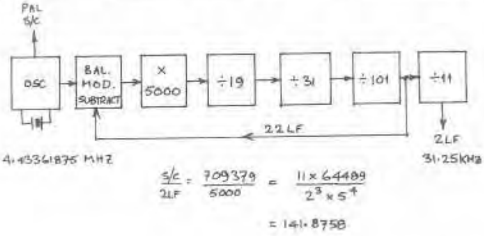
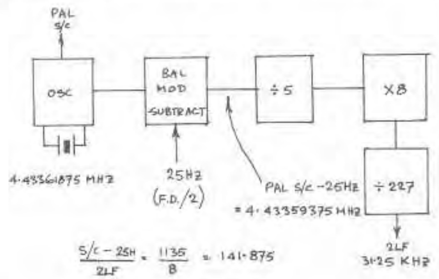


Fig 10. Counting Subcarrier down to 2LF - 625 PAL - 2nd Method.



Construction of the SPG using a printed circuit board

Figure 11 shows the track side of the printed circuit designed by the author, whilst figure 12 shows the component side layout. The board is intended to fit into either a 5¼ inches high ISEP rack-mounting frame or an Eddystone diecast box some 7 inches by 4½ inches. In the case of the latter, six small portions of the board have to be filed away and the board connections made via pins instead of a plug. The standards switch bracket is no longer necessary either as the box can support the switch. Positions of suitable mounting holes for a box version are left to the constructor.

Assembly commences with the pins for the links and with any other mechanical operations that are to be performed; e.g. the board may need trimming to size with a file for the ISEP version.

The first component that should be fixed is the 33-way plug.

Next fit the integrated circuits being sure to place the indexing mark near to the dot in the track for each device. Make sure that the leads are not doubled under the package by 'rolling' the IC into place pin-by-pin in pairs.

The diodes should be fitted next - carefully noting their polarities.

Capacitors, variable resistors and fixed resistors should then be added - in that order.

Finally, add the links. It is easiest to be methodical about this by doing first the earth links in black wire, then the +5 volts links in red and finally all the other links in turn in other colours. There are rather a lot of links because the board was made single-sided to keep the cost down to a minimum.

Carefully check over everything on the board for correct polarity, good joints and lack of solder bridges between pins, etc.

The standards changing switch should then be wired up and mounted on a bracket as required. (fig.5)

Externally link pins 9 and 27 of the plug for the +5 volts feed and set all pots to the centres of their travels.

Supplying 350 mA of +5 volts should now cause the SPG to work and it may be set up as in table 1 on page 10 of CQ-TV 75. Refer also to page 9 of the same issue.

Note. This board is not intended to be suitable for the shortened Blanking ~~version~~ but may be adapted by suitable linking

Output Stages

The pulse outputs of this SPG are of a low impedance and are designed to provide 2-volt pulses into 75Ω. However, they are not short-circuit proof. The ICs will handle a short-circuit for quite a long time if the ambient temperature is not too great, but to be on the safe side a transistor buffer stage could be added to each output.

A suitable circuit is that shown in CQ-TV 73 page 6, in the article by D.R.Taylor. This does, however, invert the waveform and so a further invertor is needed before the transistor. This can conveniently be an IC invertor. Not all the SPG outputs need these extra invertors as some already have inverting stages which can simply be bypassed.

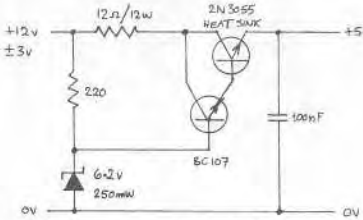
The possibility of short-circuits has not yet been found to be a problem with the SPG, but you never Know ....

Power Supply

Two circuits are given for power supply regulators suitable for use with the SPG and the additional circuitry. The first one, in fig 13, is based on the one given in CQ-TV 73 page 6 in an article by D.R.Taylor. This has a form of overload protection in the series resistor but the inclusion of this resistor gives poorer voltage regulation.

A more sophisticated circuit is shown in fig 14 and this does not have a series resistor. The regulator transistor thus has to dissipate more heat, but this is still well within its ratings.

Fig 13 Simple 5V Supply Regulator



The circuit consists of four parts. The first is a constant-current source consisting of D1,D2,R1, R2 and VT1 which forms the collector load of the second part, the voltage-comparator transistor VT2. This compares a sample of the output voltage via VR1 with the reference voltage across ZD1. D3 and D4 are included to improve the temperature stability of the comparator. They can be omitted and R6 as well if a 270Ω resistor is substituted for the lot. The third part is the series regulator proper and consists of a Darlington-pair VT3 and 4. Short-circuit and overload-protection are provided by R4 and VT5. These can be omitted if desired. 1 Ω gives 650 mA short-circuit current.

The regulator can be fed from 8 to 24 volts with a 1 % change in output voltage. Similarly the load can be from 0 to ½ Amp with only a **2** % change of voltage. The 2N3055 must have a heat sink of some 10 square inches of aluminium or so. The SPG box is suitable but will cause oscillator drift to some extent. The voltage source may be a car battery,or a transformer and bridge-rectifier as in fig 15. The capacitor should be large.

Fig14 5V Regulator for S.P.G.

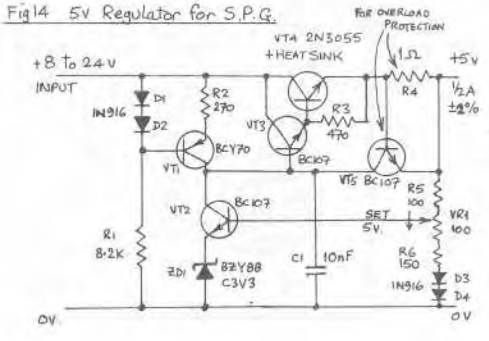
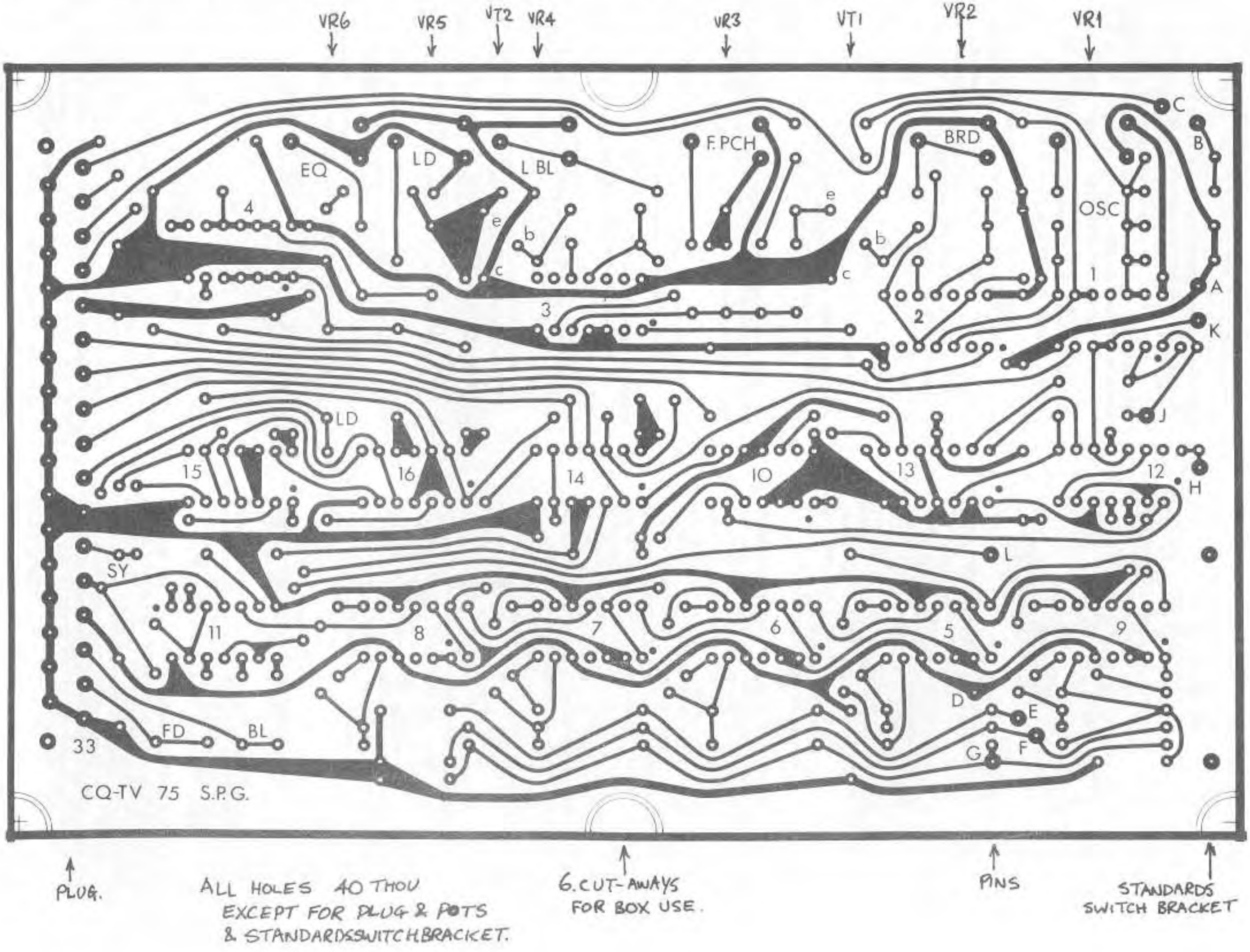


Fig 11. S.P.G. Printed Circuit (7" x 4•4" inside Border)



ALL HOLES 40 THOU
EXCEPT FOR PLUG & POTS
& STANDARDSSWITCHBRACKET.

6.CUT-AWAYS
FOR BOX USE.

Fig 12. S.P.G. Components Layout. — See CQ-TV 75. P9 &10 for details

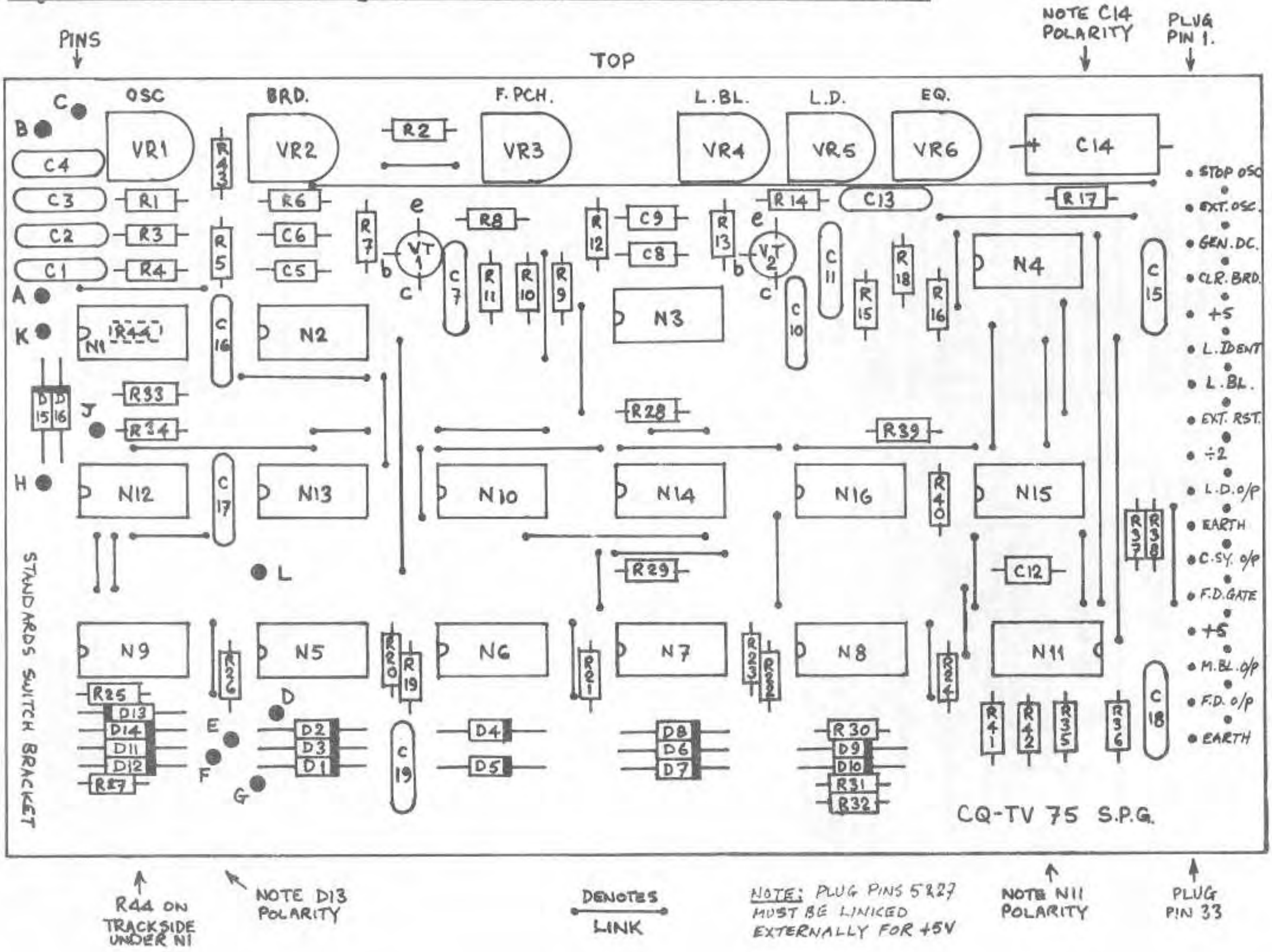
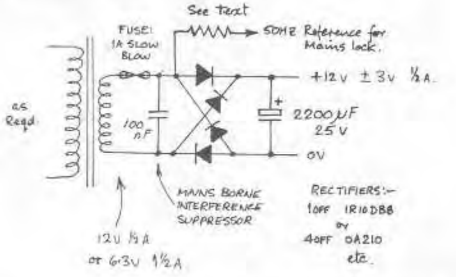


Fig 15. Power Supply Source


See text
FUSE: 1A SLOW BLOW
50Hz Reference for Mains lock.
+12v ± 3v ½A.
as Reqd.
100 nF
2200 µF 25 V
0V
12v ½A or 6·3v 1½A
MAINS BORNE INTERFERENCE SUPPRESSOR
RECTIFIERS:- 1OFF IR10DB8 or 4OFF OA210 etc.

The current required by the SPG is about 350 mA with another 150 mA or so for the additional circuitry. The transformer is therefore required to give 9 volts d.c. at 500 mA. Since this is not a common transformer rating it may be as well to use a 6.3 volt 1½ Amp winding as the light loading will cause the voltage to be about 9 volts d.c. Otherwise a 12-volt, ½ Amp winding should be used. The regulator may be run from a 12-volt car battery (negative earth).

GENLOCK UNIT

What is genlock? It is a method of locking an SPG to an external source of video by means of the synchronising pulses on that video so that the local and the remote pictures may be superimposed or faded.

The local and remote line and field frequencies are compared and a d.c. voltage produced which alters the frequency of the local SPG master oscillator to bring the two sets of pulses into step. This is done in a gradual manner to avoid interuptions of the local pictures.

There are several other forms of locking local and /or remote SPGs together. Slavelock is the opposite to genlock whereby the remote SPG is locked instead of the local one, but this is an inconvenient method because of the need for control signals. The other common form of locking is 'superlock' in which the local SPG is abruptly forced into step with the remote one.

The genlock unit described here genlocks the lines but superlocks the fields. Mains lock is not usually used these days because of the problems of generating a stable colour sub-carrier frequency. However, the genlock circuitry may be modified **for** mains locking and this is mentioned in detail later on in the article.

Operation

The basis of the operation of the line genlock is to generate a d.c. voltage from a frequency/phase difference between the two sets of sync pulses. This d.c. voltage is then used to control the SPG master oscillator frequency.

In the system described, the d.c. voltage is obtained from the output of a bistable which normally has square waves present. The average voltage, after smoothing, is thus midway between the low and high voltage limits of the bistable output. For a 7473 this is normally +2-volts d.c.

In the absence of externalSyncs the bistable triggers only from the local ones and therefore makes a square wave. The local oscillator is then set to give the normal frequency of 2LF. The bistable frequency is then LF/2.

If line-rate remote pulses are then applied to the bistable as well as the local line-rate pulses then the bistable output will be at line frequency but will not be a square wave unless the two sets of pulses are interleaved. i.e. are a half-line apart. The output d.c. voltage will vary according to the degree of this interleaving between 0 and +4-volts. Thus, if the frequencies are the same we have a phase detector.

To bring the two sets of sync pulses into line-coincidence a half-line delay must be added **in** one of them. For convenience this is made the remote sync feed and takes the form of a monostable triggered by the leading-edge of the remote syncs. The local line frequency source, on the other hand, is made Line Blanking and its trailing-edge is the trigger. Thus the monostable delay is required to be rather more than half a line. In fact it is 32µs + 12.05 µs - 1.7 µs = 42.3 µs (625)

This extra delay is very useful for it means that the monostable will not react to twice-line frequency pulses in the sync signal but only to line frequency pulses. The output pulse of the monostable is thus at line frequency only and can be directly compared with Line Blanking in the phase detector. The nett result of this is that the line-phasing is independant of the field period.

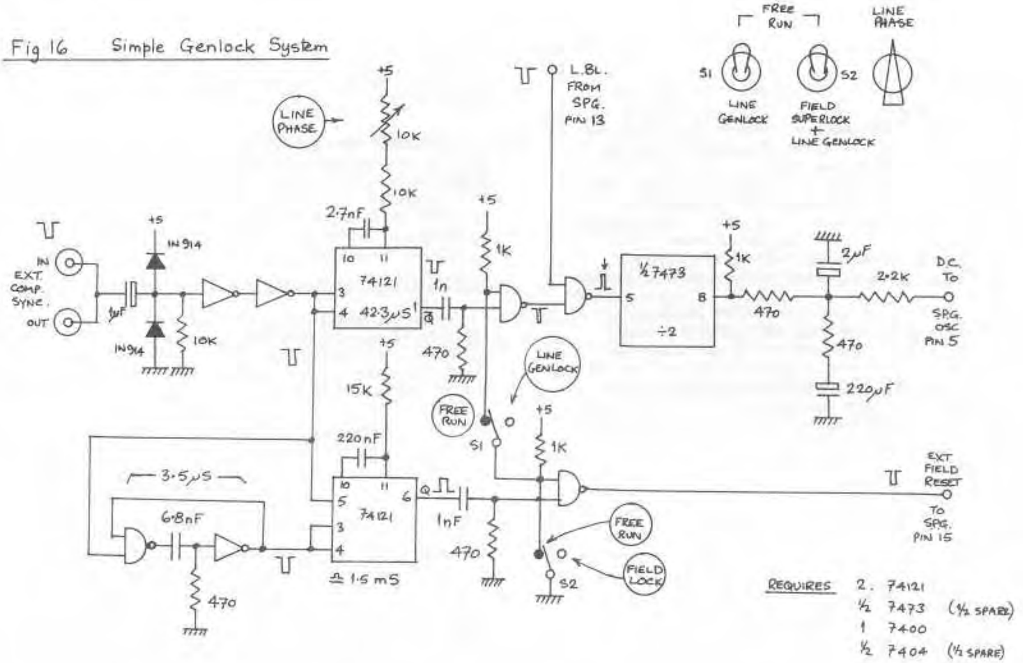
The line-phasing is adjustable by ±¼ line or so.

The circuit description for this system, which is shown in figure **16** is now given. Incoming syncs are cleaned-up by the two invertors in series. (It is assumed that these syncs have already been separated from any video) The output trailing-edge of the monostable is obtained by differentiation to form a narrow negative pulse into a two-input NAND-gate. The second input to this gate is local Line Blanking. Thus either pulse will trigger the following bistable. The output of the bistable has a pull-up resistor on it which makes the output virtually independant of the temperature characteristics of the bistable by giving it almost the full 5-volts swing. The sensitivity of the genlocking is improved by this feature as well. The output circuitry contains two time-constants. The first of these is a short one in order to allow the SPG to follow any rapid line-phase variations, whilst the second one is much longer to increase the frequency pull-in range of the locking. This time-constant is'held-off' the short time-constant by means of a 470 Ω resistor in series with the 220 µF capacitor. The effect of the double time-constant is to give a gradual change of the local oscillator frequency as desired. A half-second pull-in is typical with a range of ± 10%. If the remote sync source is removed the SPG oscillator frequency takes about 1½ seconds to stabilize at its normal frequency.

This method of genlocking is very simple but effective. However, it does not include any means of locking the fields together although once the lines are locked the fields have the same frequency.

This is overcome by a superlock system for simplicity reasons and this operates by detecting

Fig 16 Simple Genlock System



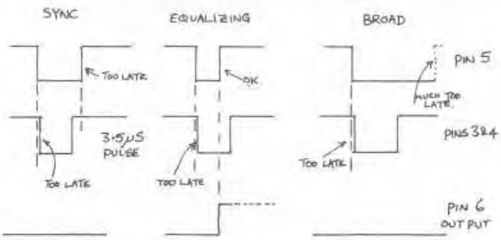
a particular pulse in the field period which is used to reset the SPG counter chain to the state necessary to cause an identical pulse in the local SPG output.

The SPG reset pulse normally occurs at the start of the field period, so that the first equalizing pulse is the particular pulse required to be detected in the remote Sync signal if the fields are to be synchronous.

Detecting this pulse is rather difficult because it occurs right at the start of the field period where the Sync pulses change widths. In order to detect a pulse, some warning of its approach is necessary so that the detection circuitry can be primed. Here, there is no chance to prime the detector as the first warning of the equalizing pulse (on one field at least) is the fact that it doesn't last as long as a Sync pulse. Thus this information must be used and results in a delay of 2.35 µs in the external resetting pulse. Luckily, this delay is no disadvantage in the particular system used here.

The principle of operation of the detector is the separation, according to length, of the equalising pulses. A simple 3.5 µs monostable is triggered by the leading-edges of the remote Syncs signal. Its output is thus longer than an equalizing pulse but shorter than a sync pulse or a broad pulse. The output of the 3.5µs monostable is used to gate a 1.5 ms monostable whose trigger pulse is the remote Sync trailing-edge. Fig.17 depicts the action of these two inputs on the monostable and shows that only equalizing pulses can trigger this monostable, and because of the period of the latter, only the first of the pulses does so - on its trailing -edge. The monostable thus produces a single pulse of 1.5 ms per field. The leading-edge of this is obtained by differentiation and forms the SPG external reset pulse.

Fig 17. Action of Monostable in detecting Equalizing Pulses



NOTE 3·5µS PULSE LEADING-EDGE IS DELAYED ON SYNCS BECAUSE OF I.C. DELAYS. THUS NEG. EDGE TO 3&4 WILL NOT TRIGGER MONOSTABLE BECAUSE PIN 5 HAS ALREADY GONE LOW - PREVENTING ACTION. NEXT TIME IT IS PIN 5 GOING HIGH WHICH INITIATES THE ACTION & THIS ONLY OCCURS ON AN EQUALIZING PULSE TRAILING-EDGE. (PIN 5 FIRES ON POSITIVE EDGES IF 3&4 LOW & 3&4 FIRE ON NEGATIVE EDGES IF PIN 5 HIGH)

The external resetting pulse is at the field rate rather than the frame rate, but is still capable of defining the particular field of its origin because of its timing relative to the lines. Since the lines are phase-locked, the two first equalizing pulses must be simultaneous if the fields are phased. The external resetting pulse ensures that the fields are phased and since the lines already are because of the genlock, the two field sequences must be identical. This is the object of the system. If the fields were not identical then there would be a half-line difference in the lines. The field phasing is therefore automatic.

The delay of 2.35 μs does not matter because the SPG reset pulse should have just occurred in the half-line period that the external resetting pulse is in. During this half-line it does not matter if the counter is reset again or not. If the resetting pulse occurs in any other half-line period then the SPG is immediately reset to the correct field phase without affecting the lines. Once in the correct phase, the external pulse may be removed without ill-effect.

This sudden jump in the field pulses from the SPG may cause trouble with some cameras in that the tubes may suffer a slight scan burn. This is not usual, though, unless an Image Orthicon is in use. Vidicons almost never aquire scan burns in this way. The alternative to the superlock arrangement is to change the line-count of the SPG to 623 or 627, in order to roll the field period into phase whilst maintaining interlace. This involves a major redesign of the counter chain of the SPG and complicates it unduly for amateur use. There is another method, though, whereby the line-locking could be performed after the fields had been brought into synchronism by changing the local oscillator frequency suitably. This method takes an undue amount of time and involves a field-detector to identify the particular field to be locked to. (i.e. 25 Hz is involved) It is also difficult to do.

The system described works well and is simple.

It is interesting to note that selecting the other output of the line genlocking bistable makes no difference to the operation of the unit.

The double time-constants are not very critical but have been optimised for good all-round performance.

It should be noted that this system of field-locking is not possible on 405 UK because there are no equalising pulses. This is one reason why the SPG was designed to provide 405 with equalising pulses as an alternative to 405 UK – so that somebody else with the same SPG system can have his pictures locked to yours. – and vice-versa.

One aspect of the line genlock is that it enables a local video monitor, or TV receiver, to be locked to a noisy remote transmission by using the local SPG. Whether or not this is better than flywheel sync has not yet been resolved, but changing the time-constants should enable a noisy signal to be locked without too much jitter.

Another aspect of genlocking is that it enables the SPG timings to be set up accurately by reference to a known accurate remote signal such as the BBC. The display facilitating this is shown in figure 2, but the local and remote pulses should be differentially added to form the video display.

No design for a printed circuit board has yet been evolved for the genlock/colour pulses systems due to pressure of work. Eventually one will be designed. It will probably be of the same size as the SPG board in order to form a suitable companion for rack-mounting purposes.

Modifications to Genlock for use as a Mains Lock

The Genlock circuit may be used for mains locking the SPG if several changes are made to it. The basic principle of varying the oscillator frequency according to a phase error still applies except that the frequency is considerably lower.

The first, and obvious, change is to make the input signals the Field Drive output and the mains reference. The Field Drive signal is conveniently available on the SPG but the mains frequency has to be obtained from the power supply. This is quite simple and requires only a single resistor of some 560 Ω if the 75 Ω termination is retained or some 47KΩ if not – see figure 15. The sine-wave is clipped by the two existing diodes to form a square-ish waveform of −0.6 to +5.6 volts. This is cleaned-up by the two invertors and triggers the mono-stable once a field. The monostable period has to be increased to 10 ms or so and this is done by making its timing capacitor about 1 μF.

The bistable should now produce a squarewave of field frequency. The time-constants on the output of the bistable now have to be greater – in theory by some 300 times. This is clearly not convenient and so a compromise has to be reached whereby the 2μF capacitor is replaced by 220 μF and the original 220 μF by a 1,000 μF or more.

The short time-constant now has to prevent the oscillator frequency from varying at a field rate. This is another form of phase modulation. Such a change of phase is usually very difficult to eliminate and much alteration of the time-constant may be needed.

The lomger time-constant is once again for the long term pull-in range and will also need to be experimented with.

The field superlock system is not required if the mains lock facility is used.

These notes on the use of the genlock for mains locking are for guidance only as the system has not been tried by the author. They are included here at the request of a reader.

Conclusions

The SPG described in this two-part article has proved to be a reliable unit. It is reasonably simple to construct and very easy to adjust. There is considerable flexibility about the design.

The SPG is easily adaptable for colour and a very simple Genlocking circuit enables local pulses to be quickly locked to a remote source of Sync pulses.

Originally the design was evolved as a suitable subject to demonstrate the uses and possibilities of TTL integrated circuits as described in the concurrent series of articles by the same author in this magazine.

An SPG based on this design is presently incorporated in a small industrial TV camera.

References

1. CQ-TV 71 to 75 for IC articles.
2. CQ-TV 63, 64, 68 and 73 for SPG articles.

Acknowledgements

The author is grateful to the Directors of EMI Electronics Ltd. for permission to publish this article.

Request

The author would be pleased to hear from anybody who has any queries or criticisms of this SPG. Please write to A.W.Critchley, at 70, Sussex RD., Ickenham, Uxbridge, Middlesex, England. - enclosing a stamped, addressed envelope if possible.

Printed Circuit

A printed circuit board for the SPG is available for about £1.75 - ready drilled.

A board for the Colour and Genlock circuits will be designed eventually.

Postscript

As a sequel to the SPG article here is a brief description of a new IC by Hughes Aircraft Company of America. :-

Type HSUB0525, it has a TO-100 can with 10 leads. It is - wait for it - a 525 SPG !

When fed with 1.008 MHz and a field reset pulse it will produce Composite Syncs, Mixed Blanking, Camera Blanking, Horizontal Blanking (Drive) and Vertical Blanking (Drive).

The system employed is the F.C.C. system and includes equalizing pulses. A 625 version is planned. Price ? about £2.50

INTEGRATED CIRCUITS

PART 6.

A.CRITCHLEY Dip El; C Eng; MIERE.

MORE TTL ODDS AND ENDS

Loading Rules again

In calculating the loadings of gates, etc., it is frequently the case that several inputs of the same gate are paralleled. The loading factor for these inputs only is not the sum of the separate loading factors nor is it the loading of only one such gate. It is in fact some intermediate value and opinions seem to vary as to its size. As a general rule the new load is about half of the sum of the loadings.

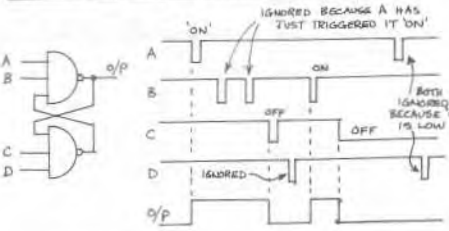
A two-input NOR-gate should, however, not have an unused input paralleled because the loading of the two inputs is in fact two loads since the NOR-gate input consists of two separate transistors. See CQ-TV 75 page 17 figure 1. The unused input of a NOR-gate should be earthed when the gate is used as an invertor.

The schmitt-input NAND-gate is another device where it may be better not to parallel the unused inputs. In this case, as for all NAND-gates, they should be returned to +5 volts via a resistor of about 1 KΩ.

Multiple-input R-S bistables

The usual R-S bistable consists of two cross-coupled two-input NAND-gates. If gates with more than two inputs are used then the extra inputs act as alternative inputs such that negative pulses to any of them will operate the bistable normally. As usual, any one of them kept low will paralyse the bistable. See figure 1. The usual condition applies wherein the pulses must not coincide - any of them. This form of R-S bistable is useful in the formation of Composite Syncs where several different pulses may be used to drive the bistable at different times. The advantage is that some gates may be saved by so doing.

Fig 1. Multiple-input R-S Bistable


A
B
C
D
o/p
IGNORED BECAUSE A HAS JUST TRIGGERED IT 'ON'
'ON'
ON
OFF
OFF
BOTH IGNORED BECAUSE 'C' IS LOW
IGNORED
o/p

Open Collector IC's

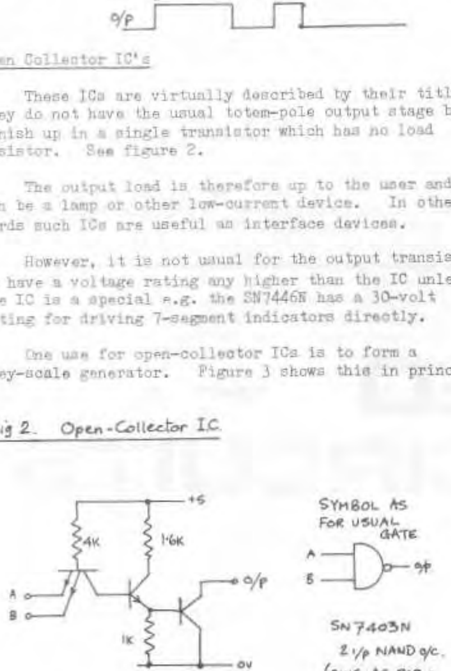
These ICs are virtually described by their title. They do not have the usual totem-pole output stage but finish up in a single transistor which has no load resistor. See figure 2.

The output load is therefore up to the user and can be a lamp or other low-current device. In other words such ICs are useful as interface devices.

However, it is not usual for the output transistors to have a voltage rating any higher than the IC unless the IC is a special e.g. the SN7446N has a 30-volt rating for driving 7-segment indicators directly.

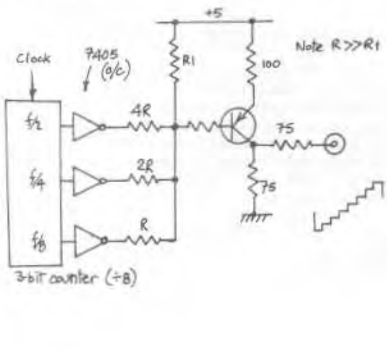
One use for open-collector ICs is to form a grey-scale generator. Figure 3 shows this in principle.

Fig 2. Open-Collector I.C.



SN7403N
2 i/p NAND o/c.
(PINS AS FOR SN7400N)

Fig 3. Grey-Scale Generator

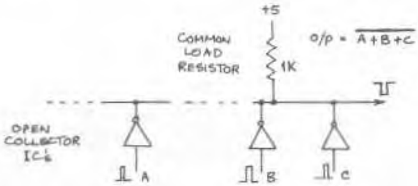


Wired-OR

This describes the connection of several ICs to a common load resistor so that any of the ICs may cause a voltage change - i.e. the OR-function. Figure 4 is self-explanatory.

This wired-OR connection must not be performed on normal TTL gates because these have low impedance in both states and can thus present virtually a short-circuit to the supply.

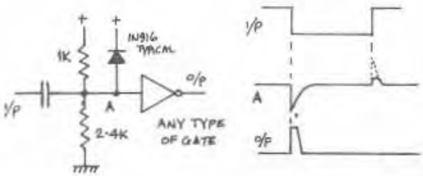
Fig 4. Wired-OR



Differentiation to obtain negative edges.

This is normally avoided with TTL circuitry because of the risk of reverse-biassing the IC input stage on the positive swing of the input. The circuit of figure 5 shows how this may be avoided by the use of a diode to shunt away the pulse. The input is normally biassed to about +4 volts and is thus turned on, but not hard on.

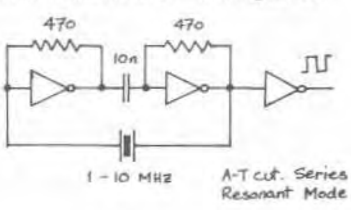
Fig 5 Negative-Edge Differentiation



Crystal Oscillator

This consists of two normal invertors, or NAND-gates biassed to their midpoints and connected in a ring via a capacitor and a crystal. This circuit is virtually a multivibrator. The crystal should be an AT-cut type with a series-resonance mode and may be from 1 to 10 MHz. A buffer is desireable. See figure 6.

FIG 6



Frequency Doubler (1)

Normally a frequency-doubler contains a resonant circuit to pick out the second harmonic, or employs a full-wave rectifier. This circuit, and the next two, use neither and do the job digitally.

The first circuit, in figure 7, uses two monostables - the first of which has a period equal to a quarter of the input period. The second monostable has a period of one half of the input. The input square-wave and the output pulse of the second monostable are fed to an exclusive-OR gate and the resulting waveform is a square wave of twice the input frequency.

Frequency Doubler (2)

The first frequency doubler suffers from having two variables with which to set the output waveform so that cascading such circuits can result in very irregular waveforms.

The second version has only one variable and is therefore easier to set up. There is, however, a 12 ns discrepancy in the output waveform which, if the multipliers are cascaded, would result in irregularities at high frequencies only.

In this circuit two edge-detectors drive a monostable from both halves of the input square-wave. The period of the monostable is one quarter of the input period. The 12 ns discrepancy arises because of the difference in delay between the edge-detectors of one gate.

Frequency Doubler (3)

The best circuit is the third one (figure 9) in which there is no difference between alternate cycles of the output frequency.

This circuit uses an Exclusive-OR gate to alternately invert the input half-cycles so that the monostable is triggered twice in each input period. The reversing of the polarity is achieved by the use of a bistable driven by the monostable $\bar{Q}$-output. This type of multiplier may be cascaded several times without trouble.

Fig 7. Frequency Doubler (1)

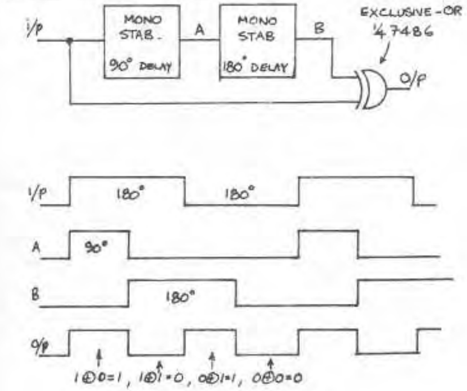


Fig 8 Frequency Doubler (2)

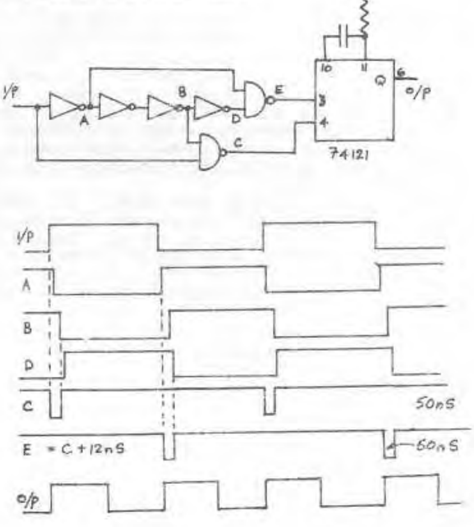
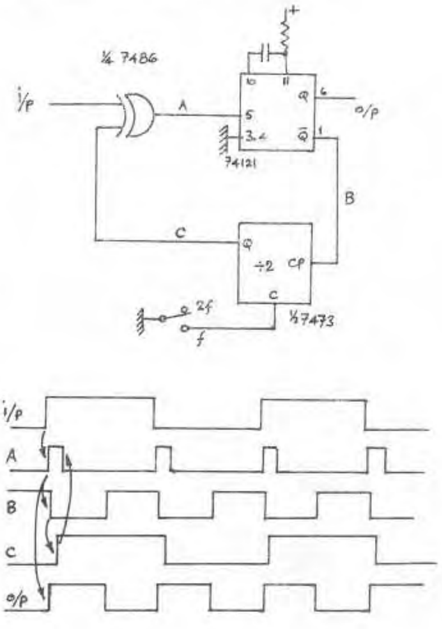


Fig 9. Frequency Doubler (3)



Using Switches (1)

Switches, or relay contacts, may be used to give ICs input information, but they suffer from the problem of bounce. This means that the contacts actually open and shut several times for each action. If the circuit being controlled is a bistable, then this will result in the many contacts each triggering the bistable and the result will be meaningless. A method of reducing the bounce to zero is wanted i.e. the contact should be made only once per action. This is not practical mechanically and so must be done electronically by means of capacitors or latches.

The capacitor method is shown first. All this does is to remove the high frequency content by simple integration. Figure 10 shows the system. There are two time-constants involved for the ON and OFF actions. Switching ON pulls down the IC input at the first touch because of the short time-constant. The first bounce open removes the short from the 1 MΩ resistor and the long time-constant takes over to hold down the input voltage. This continues until the switch is fully closed. On releasing the switch the bounce has no effect because the long time-constant is then present. This system is suitable for triggering bistables, **but** only from the leading-edge, i.e. the push of the button.

Fig 10 Using Switches (1)

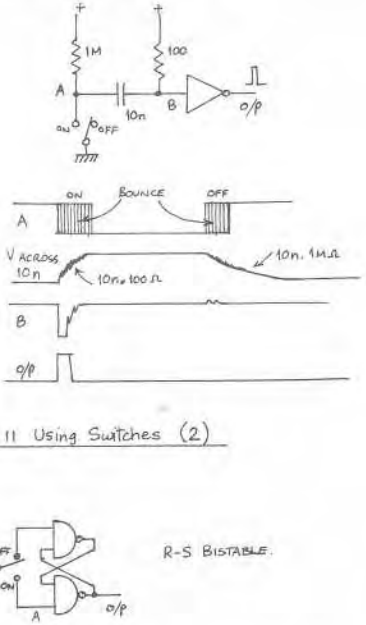
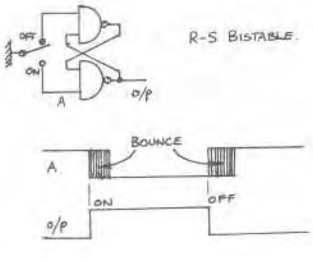


Fig 11 Using Switches (2)



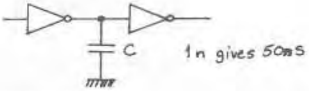
Using Switches (2)

The best answer to the problem of multiple contacts is to use a latch circuit which does not respond to the repeated input voltages. Figure 11 shows the system. This has the disadvantage of requiring a two-pole switch.

Short delays

In some circuitry a short delay is often needed to overcome a timing problem. Such a short delay can be provided by the use of the circuit shown in figure 12. The 1 nF capacitor is used as an integrator with the low output impedance of the gate and gives about 50 ns of delay. Although the gate will drive capacitive loads without trouble the rise-time of the output waveforms will suffer so that such an output can not be used to drive a bistable without another gate to sharpen it up again. 1 nF gives about 50 ns delay to both back and front of the waveform.

Fig 12 Short Delay

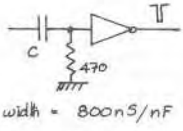


Differentiation again

The arrangement for obtaining the positive-going edges of pulses is shown again in figure 13. This is the preferred method of obtaining pulses. If negative edges are required then the waveform should be inverted so that the positive edge can be obtained by this method. - unless absolutely necessary. Then the circuit of figure 5 should be used. In the case of figure 13, the pulse-width of the output is 0.8 µs per nF.

When using a NOR-gate in this way, there is no difference in the action - the positive-edge input (as in figure 13) results in a negative output pulse just as a NAND-gate does.

Fig 13



pulse width = 800nS/nF

Removing a half-line from picture-time

When grill, or colour bar, generators are used to make test signals, the usual source of drive is Mixed Blanking. This gives the test signals directly without the need for blanking out the signals during the line and field blackout times as is necessary if Line and Field Drives are used. Whilst this gives good results it also gives one half-line at the top of the picture with a half-line displacement of the test signal. This is of no great consequence but does spoil the otherwise perfect pattern. The following circuit gives a simple method of eliminating this half-line from the driving signal, without affecting the rest of the pattern beyond a 24 ns delay.

A monostable is triggered by Composite Syncs and has a period of between 11 and 30 µs. This pulse is used to gate the Mixed Blanking in a NAND-gate and the output consists of negative-going pulses which start at the end of each blanking pulse – including the long one during the field interval. These pulses are used to trigger an R-S bistable latch whose other input is the Mixed Blanking input. The bistable thus regenerates Mixed Blanking. However, because the monostable period was less than half a line only one long field blanking period gives rise to a trailing-edge pulse; the other does not. The missing one is from the field containing half-lines. The latch thus receives two successive leading-edge pulses during this interval and consequently ignores the second one. The result is therefore Mixed Blanking – with a half-line missing. See figures 14 and 15.

Fig 14 Removing half-line from picture

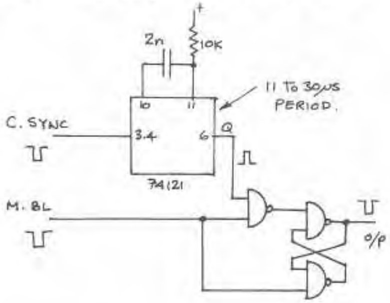
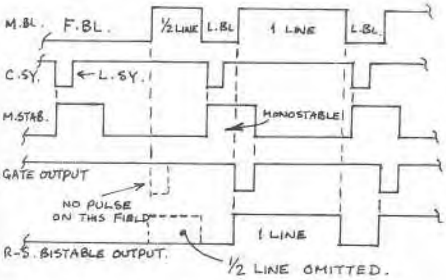


Fig 15 Removing half-line from picture.



Line Standards Detector

The two most common TV line standards are 525 lines 60 fields per second and 625 lines, 50 fields per second. An automatic standards detector could be a useful device where both of these standards are in use.

The basis of detection is that the two field periods are different. They are 16 2/3 ms for 525 and 20 ms for 625.

Fig 16 525/625 Standards Detector

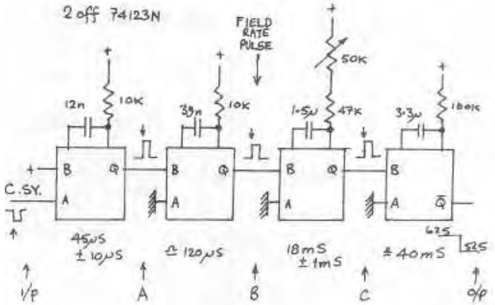
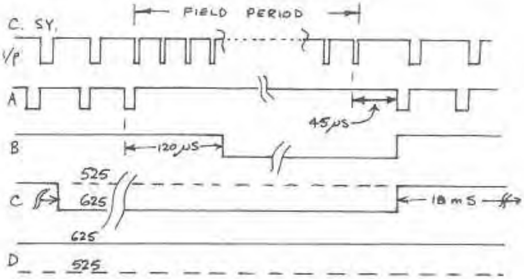


Fig 17 Standards Detector Waveforms



example of the use of the Dual retriggerable Monostable SN 74123N and can be split into two parts. The first part consists of two monostables which generate a field rate pulse and the second of the detector proper.

The field rate pulse can be derived from any source but the circuitry shown enables it to be generated from Composite Syncs. The action is shown in figure 17.

Incoming Syncs trigger the first monostable which has a period of about 45 µs. This is longer than a half-line and so during the field period when half-line pulses are present, the monostable Q-output remains up. The second monostable has a period of greater than one line and so its Q-output is high except during the field interval – i.e. it gives a field pulse out.

These field pulses trigger the third monostable which has a period of 18 ms ±1 ms. This value is between the two standards field periods and so on 625/50 the monostable output is a series of 18 ms pulses with 2 ms gaps. On 525 the output is continuously high. This state of affairs is detected by the fourth monostable which has a period of some two fields. Its Q-output is continuously high on 625 because of the input pulses but on 525 there is no input (only d.c.) and so no output occurs.

There is no need for great accuracy in the various periods except for the 18 ms one and so variable timing controls should not be necessary.

Fig 18 Alternative Field Pulse Generator (from Syncs)

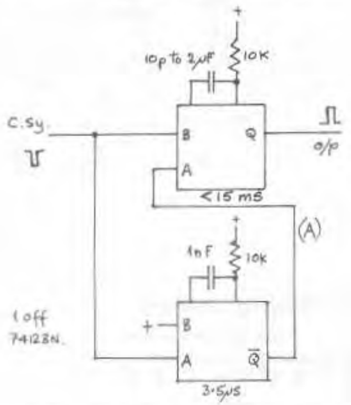
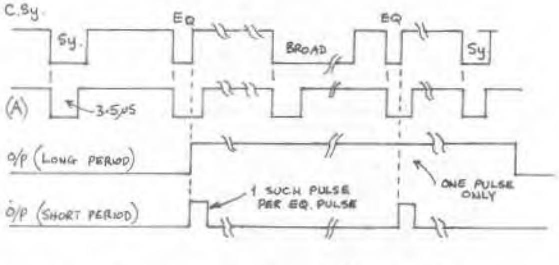


Figure 18 shows an alternative method of obtaining the field pulses from Composite Syncs. The advantage is that smaller capacitors are involved. The circuit operates by detecting pulse-width differences between Syncs and Equalising pulses.

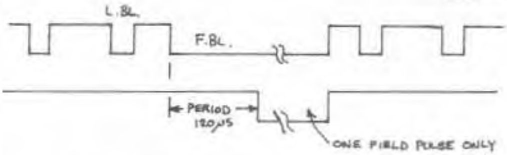
The 3.5 µs monostable period is set between the limits of these two kinds of pulses which are 2.35 µs and 4.7 µs and its output used to gate the second monostable. The period of this one may be any value from the minimum of some 30 ns to some 15 ms. Figure 19 shows the action of the gating on the triggering of this monostable and it can be seen that the triggering takes place at the trailing-edges of the two groups of the Equalising Pulses. If the monostable period is shorter than half a line then the output is 10 such pulses. If it is longer then the output is one long pulse. Either way, the 18 ms monostable is provided with a trigger which causes it to make a field rate pulse. Thus the nett effect is the same but with smaller capacitors - indeed the second monostable may work without one at all.

Fig 19 Waveforms for fig 18 Circuit.



If Mixed Blanking is the available feed then only three monostables are required to do the job. The first one is given a period of greater than one line and thus produces the field rate trigger directly for the second monostable (18 ms). See figure 20.

Fig 20. Waveforms when M.BL. used as input to 120µS M/S of fig 16



This application of the SN 74123N is one that could be considerably more difficult to do without the retriggering facility. For details of the input triggering pulses see CQ-TV 74 page 21.

Conclusions

This series about TTL (and RTL) digital integrated circuits should by now have given the reader a good idea of how to use the devices. There are very few rules to follow and these are quite simple because the designers have eliminated the difficult ones in the basic design of the ICs.

Since the devices are digital it does follow that a good knowledge of pulse techniques helps a great deal, but for television purposes the greatest asset is a thorough knowledge of the various standard pulses from the SPGs. The derivation of the IC circuitry is then largely a matter of common sense, but trial-and-error, plays a large part in it!

The best way to work out IC circuits is to have a go yourself and see what happens. It is not very likely that you will do them any harm even is you change the interconnections whilst they are on. You will usually require a good oscilloscope because the pulse rise-times are very short and spikes can easily be missed - even with a professional oscilloscope of high bandwidth.

In future issues

This series of articles has not discussed shift registers in any detail so far, nor has it mentioned several other Medium Scale Integration (MSI) devices such as memories, coders, decoders, arithmetical units, etc. The next issue of CQ-TV, No 77, will describe shift register ICs and memories in detail. The other types will follow in later issues.

It is not proposed to mention anything about DTL ICs as these are not available in anything like the range of TTL to the amateur; they are also more expensive at present and do not have any advantages for Amateur TV use.

MOS devices may be mentioned in the future as may certain linear ICs

It is hoped to describe the colour pattern generator displayed at CAT-70 and the RSGB show in a future issue.

Grille Generator

The author apologises for the non-appearance of the grille generator circuit mentioned in several previous issues of CQ-TV. This is due to the fact that it was promised to a leading electronic magazine and subsequently published by them. As they hold the copyright the circuit can not be published in CQ-TV. However, another grille generator circuit will be designed and described in a future issue. Of course, you should be able to design your own now.....

Apology

Due to domestic circumstances it has not been possible to check all the component values of the circuits described in this part of the series. Any errors will be corrected next time round in CQ-TV 77.

Acknowledgements

The author wishes to thank the directors of EMI Electronics Ltd. for permission to publish this series of articles.

References

CQ-TV 71 to 75 for IC articles.
CQ-TV 75 and 76 for a TTL SPG.
Wireless World, August 1971, page 368;
Crosshatch and Dot Generator, by A.W.Critchley.

POSTBAG

Maitland Lane VK5AO/T of Henley Beach, S.Australia writes to tell that he is now on the air PAL colour with three vidicon camera. His current project is the G6KKD/T combining unit from CQ-TV 66, and Maitland claims his area to be the centre of Australian amateur tv with 6 active stations. Together with VK5ZEF/T experiments are now going on into the best type of aerial feeder to meet local conditions.

L.J. O'Laughlin G6AGC/T from Scarborough sends a progress report on his station, which is now radiating video from a low power tx. He has decided not to modify his 40 watt 70cm equipment until more experience has been gained in video matters, and is at present using a purpose built QQV02-6 PA modulated by a BF179/2N3440 running at approximately 5 watts peak white. Present camera is a borrowed NEV 405 line vidicon, but an industrial Marconi vidicon is in the offing. The aerial is a 46 element Multibeam at 40ft, and the receiver is a Pye V710D with a BF181 UHF tuner and an AF279 pre-amp. Using a CQ-TV 56 type probe unit into a three transistor video amp, the V710D is also used as an off-air monitor. G3ZJY in Bradford (60 miles) and G8AWN in Otley have successfully copied AGC/Ts signals which is good for 5 watts. Later projects will include a QQV03-25P.A., a vestigial sideband filter and a switchable 625/525/405 camera. Frequency is 437.04MHz with audio/talkback on 433.20MHz and 145.35MHz.

Rudi Berg DC6VD is the Public Relations Officer of the German amateur tv club "Arbeitsgemeinschaft Amateurfunkfernsehen" and has recently written to us about his club. He is very interested in co-operation between B.A.T.C. and Germany, through their journal "TV Amateur" and through contacts between members. His address is Karl Ulrich Str. 29, D - 6842 Burstadt.

V.R. Krause ZS6VK of Johanesburg, S.Africa is very active on 432MHz using 625 lines, writes that he is busy with a transistor modulator at the moment. Thanks for your nice comments on CQ-TV!

C.D. Hoffmann DC9DR of Konigswinter, Germany has started another amateur magazine which should soon be appearing with reprinted CQ-TV articles. An exchange scheme has been started so that amateurs can read the articles in their own language - in German in "Amateurfunk - Magazin" and in English in CQ-TV.

ADVERTS

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Any offers for Telequipment 26 valve 405 line SPG with monitoring 'scope and homebuilt PDA?

M. ALLARD G6AEM/T
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Also some Japanese f1.4 - 22 one inch lenses suitable for "C" mount tv cameras Price £7.50

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FOR SALE Two 75 ohm video faders. These are ex-equipment high quality video attenuators intended for use in vision mixers where the video signal actually passes through the fader. Only £3.00 the pair.

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FOR SALE tv response one inch lens, f1.9 - 16 suitable for "C" moumt cameras. If required, a "C" mount can be supplied. Price £5.50

The almost complete remains of the camera shown on the front cover of C Q - T V No.59 which comprises of:

Camera case with yoke, head amplifier, focus mechanism, line and field boards;

CCU containing processing amplifier and various controls;

Camera cable (multiway, 10yds x $\frac{1}{2}$" dia. inc plugs and sockets)

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J. E. NOAKES G6ABA/T
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Camberly, Surrey.

IN THE NEXT C Q - T V

Colour Television for the Amateur

A Multiburst Generator using I.C.s.

All the usual articles again.

Club Sales Price List

Camera Tubes: English Electric P849 Amateur grade	£10.50
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9728 Amateur grade	£10.00
(non separate mesh) 10667 Amateur grade	£8.00
4½ inch Image Orthicon 9564 or 9565 (older "sticky" target type)	£10.00
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Vidicon Deflection and Focus Coil Assembly	£6.50
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'C'-Mount in aluminium for use with cine lenses	50p
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B.A.T.C. Reporting Chart. A visual scale of video noise	6p
Notepaper and envelopes (100 sheets)	75p
Filmstrips of CQ-TV. 10 copies on each film (Please state which decade you require, ie. 31-40, 41-50 etc)	£1.00

Please send cash with orders to:
B.A.T.C. Club Sales,
"Kyrles Cross",
Peterstow, Ross-on-Wye,
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J.B. PROCTER G8AWN
Crag House,
Snowdon,
Otley, Yorks.

IS THERE ANYTHING YOU WANT ? If there is why not write to the Club Equipment Registry (the address is on page 1). This is a service for members who have spare equipment to dispose of and for those who have definite requirements. There was a form on which to list your details in CQ-TV 74; reprints are available from the Registry.

Please mention CQ-TV when replying to advertisers.